BELL TELEPHONE QUARTERLY

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JULY, 1932

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AMERICAN TELEPHONE & TELEGRAPH CO.
NEW YORK

1932 Republican and Democratic Conventions.

Composite photograph of a section of the convention hall at Chicago showing seating arrangements of delegates, alternates and newspaper writers and arrangements for radio broadcasting. The two parabolic microphones were designed to pick up the voices of speakers from the floor. During the Democratic convention these were supplemented by a number of Western Electric lapel transmitters, carried to the speakers by floor pages. The box-like loud speakers are part of the permanent system in the stadium. The horns were installed especially for the conventions.

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A Medium of Suggestion and a Record of Progress

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Communications and the National Conventions

INAUGURATING the second century of national conventions as instrumentalities in American political action, the two major parties have just concluded their 1932 meetings, both held in Chicago. Equally responsive to the demand for the special as well as the usual in their services, the electrical communication systems of the country—the local and long distance telephone, the telegraph and cable, radio broadcasting and telephotography,—have contributed each an important part in planning, preparing for and conducting these conventions, as well as in interpreting them to the public.

The political philosophy which underlies party conventions is bound in with communication. The convention proceedings are the first formal act in the party's campaign for votes, a campaign to be furthered during the next few months by every method of communication by which the public eye, ear or consciousness can be reached.

To use a trite, but in this case justifiable expression, "a modern miracle" was performed and repeated every moment of the two conventions. So comprehensive were the services of communication that any person in the United States, with access to a radio receiving set, might, if he chose, listen to every speech and hear on the instant every word spoken in debate. If he did not care to follow the proceedings, which sometimes lasted far into the night, his daily newspaper, issued perhaps a thousand miles from the convention city, would give him frequent reports of the convention activities, with photographs taken on the scene and transmitted by wire. If he wished to send a message to his own delegates or talk to them in person, the convention hall was equipped with telegraph and telephone

service drawn to the last notch of efficiency. If his interest required contact out of convention hours, he would find the wire facilities at his call to penetrate hotel rooms, committee rooms and headquarters.

Many profound political developments in American history are readily traceable to the lack of adequate communication between different sections of the country in the early days of the republic. In those days communication with those at a distance meant just one thing—travel; travel in person or by messenger, on foot or horseback, in the lumbering coaches of the day, or by sea. When the nation was founded there was scarcely a single highway worthy of the name in the thirteen states. Main roads were deep in mud or dust and side roads were little better than trails. The traveler forded the small streams and was ferried across the large ones. These conditions had their influence in shaping the very form of the government itself. The provision in the constitution that presidential electors shall meet in their respective states was no doubt dictated, in part, by the difficulties of travel, otherwise the obvious arrangement would have been for the electors to meet in some central place. The plan adopted required a single messenger from each state to make the journey to the seat of government. The interval allowed between the casting of the votes and the inauguration of a president was due, probably, to the time necessary to collect the electoral ballots and complete the election. The time required to reach the capital was also the reason for the long interval between the election and induction into office of members of Congress, whence come the "lame duck" sessions. So important was the factor of travel that Alexander Hamilton in a scheme of government which he presented to the Federal Convention, proposing that senators be chosen for life and representatives for three years, wondered "if gentlemen could be induced to make a journey of six hundred miles to attend the national legislature." After the government was established improvements in transporta-

tion methods and facilities for travel came so slowly that to gather an assembly from all parts of the country would obviously have been a major operation in those early years, only to be undertaken for the most imperative reasons. A session of Congress, for which the members received compensation and mileage allowance, justified a long journey, but such a thing as a gathering of delegates in a brief meeting did not enter into the political program for almost half a century after the foundation of the government. Organized political action in the early days took the form, for the most part, of the caucus, and in national elections the Congressional caucus assumed the right of choosing presidential and vice presidential candidates and writing the party platforms.

Even after conventions were established as methods of party action, the time element, the season and communications were governing factors. Former Governor Alfred E. Smith comments on this in a recent magazine article. "I have often asked myself the question, without hope of a satisfactory answer," he wrote, "'Why is it necessary to hold the national convention in the month of June?' As I look for the answer, I find that years ago the delegates required several months to get to the convention and then back to their home towns. After the nomination nothing of much importance to the campaign could happen because there were no modern means of communication, there being no telephones, no rapid railroad transportation and no radio, no airplanes and no . . . transmission of photographs or the ever present motion picture and news reel."

The first party convention organized on a nation-wide basis was held just one hundred years ago to renominate President Andrew Jackson. As the place for this first convention Jackson chose Baltimore, which was connected to Washington by the newly constructed Baltimore & Ohio railroad, which offered the quickest means of communication then in existence anywhere in the country.

Two events of lasting importance opened the campaign of 1844. For the first time one of the parties named a "dark horse" for President and for the first time also, electrical communication entered the picture. At the time of the Whig convention, in May, the first telegraph line in America had been completed from Washington to a point about fifteen miles from Baltimore. When Henry Clay was nominated for president, newspaper reporters boarded a train, rode out to the point where work on the telegraph line was in progress and from there sent the announcement of Clay's nomination by telegraph to Washington, where it was received in the Supreme Court room of the Capitol by a waiting group of Whig leaders. This was the first telegraphic report of a national political nomination. When the Democrats met three weeks later, the line was finished and instruments were in place in the railroad station. Reporters hurrying from the convention hall to the station flashed to Washington the news of the nomination of Polk. This was so unexpected that some in the group of Democrats gathered in the Capitol refused to believe it. But the message was correct and the reply that went back, "Hurrah for James K. Polk!", was received in the Baltimore convention before the chairman had officially announced Polk's nomination.

The Republican convention of 1860, which nominated Abraham Lincoln, was the first of a long succession of conventions to be held in Chicago and is reported also to have been the first to which spectators were admitted. The sessions were held in a "wigwam," a wooden building constructed for the purpose. When Lincoln's nomination came, the result was proclaimed by firing a cannon from the roof of the wigwam, a form of "broadcast" in vogue at that time. Lincoln was in his law office in Springfield, Ill., when he received the telegram announcing his nomination. "There's a little woman over on Eighth Street ought to know about this," he said. Of course there were no telephones then. Lincoln walked home. Five

months later, on election night, he sat in the little telegraph office in Springfield, receiving frequent news of the counting of the ballots. When the message came that New York had gone Republican he felt sure of his victory. Again he walked home. Mrs. Lincoln was waiting. "Well, Mary," he said, "I guess we're elected."

In 1860 the pony express service started and one of the earliest relays of riders who crossed the western plains and mountains carried the news of the nomination of Lincoln. The fastest trip ever made was by those who bore copies of Lincoln's inaugural address. The following year the telegraph was lifted over the mountains and the brief but exciting career of the pony express soon came to an end.

The Chicago convention of 1868, which nominated Grant and Colfax, was held in Crosby's Opera House. According to a newspaper account of this convention, a telegraph office was fitted up in the south proscenium box for the convenience of the Associated Press, whose reporter (only one, it seems) had a table in front of it. This is the first installation on record of special wires for the purpose of reporting a national convention, although at previous conventions the telegraph companies had always made arrangements to handle a larger than normal volume of traffic.

The telegraph, with its splendid service and facilities, still remains an important instrumentality for conducting the business of national conventions and supplying reports of their activities, particularly to the newspapers. But in later years the telephone and radio broadcasting have also become of major importance.

The first conventions held after the beginning of telephone service were those of 1880. The service at the time was local only. An item in a Chicago newspaper of May 26, 1880, a few days before the Republican convention, stated that "Just as the local executive committee had adjourned, somebody called through the telephone for Mr. Jesse Spaulding. He

went to the instrument and was informed that the anti-Grant men wanted the Exposition Building to hold their indignation meeting in." Here was the first, so far as the records show, of the thousands of telephone messages which have gone into and out of convention committee rooms—messages which have had tremendous influence in shaping convention results.

The practice of admitting spectators, begun in the Chicago wigwam in 1860, had been continued in later conventions of both parties with a constantly greater demand on the part of the public for admittance. And, with the addition of new states to the union, the conventions themselves had grown larger. To accommodate this demand, larger and larger wigwams, "amphitheatres" or exposition halls were provided or requisitioned. The practical ultimate in such buildings was reached in the construction of the Coliseum in Chicago. Due to the limitations of the human voice, the size of this hall was just about the maximum for a place of public assembly. Five Republican conventions, the last in 1920, were held in this building.

In 1920 a new development perfected by Bell System engineers was demonstrated for the first time in a national convention. This was the public address system with the familiar loud speakers. With this system everyone in the big Coliseum could hear perfectly the proceedings on the platforms and from then on the conventions took on a new character. Since the public address system accommodated a vastly larger audience, recent conventions have been held in the largest halls in the country. No doubt the selection of Chicago in 1932 was partly due to the completion of the Chicago Stadium, which will seat about 22,000 persons. It appears that the size of halls of the future will be governed only by structural limitations. The problem of hearing is entirely solved.

The first transmission of an audible reproduction of convention proceedings to a distance took place in 1908 when, at the request of President Roosevelt, engineers of the Bell System

installed in the Chicago Coliseum a set of four sensitive transmitters which were hung about ten feet above the heads of the delegates and a few feet in front of the platform. These were connected in a circuit running from Chicago to the White House in Washington. The president, with receivers clamped to his ears, was able to listen to the "keynote speech" of the temporary chairman, Henry Cabot Lodge, and to hear the cheering, which lasted forty-seven minutes, when his name was mentioned by the speaker. But Roosevelt was not a candidate that year and the next day Taft was nominated.

This was a service for one listener only, but by 1924, when the Republicans met in Cleveland and the Democrats in New York, radio communication had become an established service and chain broadcasting had been successfully developed. The first commercial broadcasting station, KDKA in Pittsburgh, had begun its career on election night in 1920 and its first program was the broadcast of election returns. Both 1924 conventions were broadcast over small chains covering the eastern and central parts of the country. The long drawn out proceedings of the Democratic meeting in Madison Square Garden, New York, were broadcast at great length and into the small hours of the morning. The almost endless repetition of the words, "Alabama casts twenty-four votes for Oscar W. Underwood," as ballot followed ballot in the long deadlock, was heard day after day by radio in so many homes that the expression began to take on the flavor of a tradition. By 1928 the chains broadcasting the convention had grown to sixty, in forty-three cities in all parts of the country. Chain broadcasting combines the services of the telephone lines and the local broadcasting facilities. The radio system operates the broadcasting service and the Bell System supplies the wire lines which connect the various stations throughout the country which make up the chains and which receive identical programs by means of these lines. During the 1932 conventions Bell wires linked 181 stations of the National Broadcasting Com-

pany and of the Columbia Broadcasting System with announcers' booths in the Chicago Stadium. The importance of these broadcasts is second only to the service of the newspapers, on which, of course, most Americans depend for the presentation and analysis of the news of the conventions.

The two conventions of 1924, the Republican in Cleveland and the Democratic in New York, also brought the first public demonstrations of the Bell System's newly developed method of transmitting pictures by wire. In a demonstration at Bell System headquarters, New York, on the afternoon of May 19, 1924, the first press telephotographs had been transmitted. By the time the Republican convention met on June 10 of that year this method had been fully tested between Cleveland and New York and throughout the convention pictures taken in Cleveland were regularly published the same day in the New York newspapers.

Telephone service constitutes the nerve network joining convention halls with committee rooms, campaign headquarters and the homes or offices of candidates and other interested persons in distant parts of the country. The first instance of special arrangements to provide continuous contact between a candidate and his headquarters was recorded twenty years ago when the home of Theodore Roosevelt in Oyster Bay, New York, was connected with the Congress Hotel in Chicago over a leased telephone circuit. This was in service a week before the Republican convention and enabled the former president to direct all details of his campaign. Later, however, he boarded a train and rushed to Chicago where he was on hand to deliver his famous Armageddon speech before the Progressive or "Bull Moose" convention, which followed his defeat in the Republican meeting. A recent magazine article says that Senator Penrose of Pennsylvania, who was prevented by ill health from attending the 1920 Republican convention, communicated frequently with the Pennsylvania delegation over the long distance telephone and consented to the switch

of the Pennsylvania votes to Harding, breaking the deadlock in that memorable meeting.

As was pointed out by Mr. Arthur W. Page in his recent address before Lowell Institute, the ancient forms of communication "were an essential part of the machinery by which a small ruling class kept large populations in subjection. These communications were largely made up of the military and political information necessary for the conquerors to maintain this rule over the populace. Modern communication is chiefly useful so that large populations may know themselves, by constant intercourse, and thereby improve their economic status and their ability to govern themselves. The underlying purpose of the two systems is exactly the opposite. One gave inside news exclusively to the few. The other is to enable every one to have the same news at the same time and to have equal facilities for personal communication. One tended towards exclusive power, the other tends towards equalization of opportunity. Communications are now one of the great agencies of democracy."

The outline which we have just traced by means of a few references to history, serves to emphasize the contrast between the old and the modern in communications in their relation to political action in our own country and to show how the forces of reaction, which were strong in early days, have gradually, and in recent times, rapidly, yielded to the demand for complete, continuous and instant information and publicity concerning all matters of government and party action.

The physical means whereby the comprehensive systems of communication associated with national conventions are established and operated doubtless receive little consideration by a public accustomed to enjoy the benefits of science in so many fields, but the magnitude of the job makes the story impressive when the various agencies involved are marshalled in review. To obtain the results demanded by the public and by those participating in the two conventions in Chicago, re-

quired both the separate and the co-ordinated services of all forms of electrical communication.

There were several groups to be considered in the setup of communication facilities. First, those in the convention hall itself; second, the newspaper-reading public; third, the audience of many millions listening from radio receiving sets all over the country, and finally those who might desire individual communication service on matters connected with or growing out of the convention.

The Chicago Stadium, designed primarily for athletic contests, was transformed for the conventions into a vast auditorium. The speakers' stand which projected deep into the center was equipped with microphones both for the general broadcast and for the public address system within the hall. As the convention proceedings would be made up entirely of speeches and debate by speakers having every degree of voice quality and voice capacity, it was thought best to reinforce the public address system already in place in the Stadium, which was designed to be used by trained announcers. This was done by a special installation which practically doubled the capacity of the system and was so effective that those in any part of the hall, which is more than two hundred feet in length, were able to hear. To take care of a possible overflow crowd, an additional battery of amplifiers was installed in Union Park about two blocks from the Stadium.

The press stand stretching the full length of the floor on either side of the platform was crowded at each convention with more than seven hundred newspaper men and women from all over the country and some representing foreign papers. To quote a prominent newspaper writer in his description of the Republican convention, "a flood of news and feature matter was loosed on bolts of lightning in total six-day volume believed to be not less than five million words, filling daily as high as eight or ten pages of metropolitan newspapers." This, of

course, included press dispatches covering preliminary news of the convention. No corresponding estimate of wordage on the Democratic meeting is available, but it was doubtless as great, or greater. There were several telegraph instruments working directly from the press section and the Associated Press had a teletypewriter working within a few feet of the rostrum. Four press associations maintained large workrooms in the Stadium close to the convention floor. Writers, working in relays, took notes in the convention and went to these workrooms where their stories were written and transmitted over telegraph or teletypewriter circuits to all parts of the country. On the lower floor of the Stadium were about fifty smaller workrooms used by Chicago newspapers and by special correspondents of papers in other cities. These workrooms were equipped with telephones, teletypewriters and telegraph instruments.

To care for telegraph, telephone and teletypewriter facilities for the press, the Illinois Bell Telephone Company set aside a special one hundred pair cable terminating in an American Telephone and Telegraph Company loop board installed in the basement of the Stadium. From this board branch cables were carried to the various workrooms of the press associations and individual newspapers and to the press section on the convention floor. The Western Union and Postal Telegraph companies also maintained large workrooms where they handled a heavy volume of press dispatches and private messages.

The Bell System's telephotograph service played a prominent part in telling the world the story of the two conventions in pictures. Four press picture services were daily users filing photographs for transmission to all parts of the country reached by this service. The Chicago telephotograph office, two miles from the Stadium, was a busy spot during the two conventions. Press photograph services worked feverishly in the race to take, develop and start on their way around the country over Bell System wires pictures of the convention actually in session. One of the press photo services supplying pictures to about six

hundred newspapers in the United States and many more in foreign countries, established a temporary finishing plant across the street from the telephotograph office. Films of the first pictures taken in the convention after the sessions opened, were placed in an ambulance, obtained for the occasion, and rushed to the telephoto office under motorcycle police escort. Finishing equipment had been set up in the ambulance and the films were developed en route, ending the two mile trip six minutes after the pictures had been taken. Other press photograph services also used the telephotograph service liberally. Several pictures sent by wire to New York on the first day of the Republican convention were on steamships headed for Europe the same evening.

Perhaps the feature of greatest immediate interest to the largest section of the public was the arrangements for radio broadcasting. Extensive use was made of Bell System facilities both by the broadcasting companies and local Chicago stations. Above and back of the speakers' platform was a row of five glassed-in radio control booths operated by the National Broadcasting Company, Columbia Broadcasting System and three Chicago stations. In each booth occupied by announcers and radio engineers were microphones, telephones and control equipment. In addition to the microphones in front of the speakers' platform, the National Broadcasting Company had two parabolic microphones, one set up at each corner of the platform, to pick up speeches from any part of the floor, as well as to register the applause and demonstrations. These conventions were the first to use this type of microphone, which may be aimed or focused in any direction and is designed to pick up and amplify the voices of floor speakers. The Columbia System also had five special microphones in various locations around the hall.

At the Democratic meeting the first use for convention purposes was made of the new Western Electric lapel type microphone, developed by Bell Telephone Laboratories. Micro-

phones of this type, suspended on long cords, were carried on the coats of pages. When a delegate spoke from the floor, a page placed himself so that the microphone would pick up the sound of the speaker's voice, carrying it clearly both to the convention and the radio audience.

All microphone locations were connected with the control booths by telephone so that announcers, directors and engineers were in constant communication. Telephone talking circuits also connected the control booths with the main Chicago studios of the broadcasting and chain systems and with their studios located below the platform, which were used for broadcasting informal talks by prominent men in the convention. Some of the broadcasters also operated temporary studios in the Congress Hotel for evening broadcasts and these studios were connected to the broadcasting stations by Bell wires.

To care for individual, public demand for service into and out of the convention hall, an attended public telephone station of twenty-eight booths was installed in the corridor of the Stadium to supplement the thirty-nine booths already permanently in service. Committee headquarters and candidates' headquarters in the hotels were supplied with individual telephones or private branch exchanges. One such private branch exchange utilized a three-position board with twenty central office trunks and seventy terminals.

The American Telephone and Telegraph Company, Long Lines Department, and the Illinois Bell Telephone Company made careful preparations for giving the services required by the national conventions. To such an extent has the telephone communication system developed, however, that these preparations consisted mostly in the proper arrangement of standard facilities, care in the selection of supervisory and operating personnel and care in handling details. The types of plant already in ordinary use were readily adaptable and standard traffic practices in every way suitable.

G. K. McCorkle

Some Recent Developments in Underground Conduit Construction in the Bell System

FEW users of the telephone have any conception of the myriad problems which are met in rendering the highly complex service of telephone communication. Infinite attention to details is essential to telephone progress. In this article a brief account is given of how the problems related to one particular detail were solved by careful attention and patient experimentation.

Hidden beneath the surface of the ground there exists in the Bell System over 600,000,000 lineal feet of underground duct. These miniature tunnels radiate in groups from the central offices or extend for miles across country along many of the toll cable routes. They are part of the underground system of conduit runs, which are provided as a ready means for the installation of underground cables and, when necessary, for their removal. While recent developments in the application of protective coatings on lead covered cable have made it possible to bury cables directly in the ground with a minimum of danger from sheath corrosion, such installations are generally restricted to those cases where there is little prospect of a second cable being required for a number of years.

The extension of underground construction of both conduit and buried types is continuing from year to year. Where these are employed instead of aerial construction it is usually because of economic reasons. In those cases where large aggregations of cable facilities are required, they can generally be supplied less expensively in the form of underground cable in conduit. In other cases, conduits may be employed because of physical

conditions or where public improvements make underground construction preferable.

Excavating for underground construction is expensive, especially when it involves breaking through pavement, and the cost of restoring pavement is another considerable item. Accordingly, at the time the first underground cable is required along a given route, where additional cables will be frequently needed, it is customary to place sufficient duct facilities to care for the cable requirements over a period of years shown by engineering studies to be economical.

Many different types of conduit have been employed in the Bell System, and many other types used by other companies, both here and abroad, have been carefully investigated in arriving at our standard practice. This practice employs vitrified clay conduit, in either single or multiple duct units, for main line conduit runs with subsidiary or branch runs constructed of creosoted wood duct, fibre duct, vitrified clay sewer pipe or steel pipe. (See Figure 1.)

We are fortunate in the telephone field in being able to make use of multiple duct conduits. This type of construction is essentially less expensive than that employing single duct conduits, which are generally assembled into a conduit run with all of the joints staggered and the whole encased in concrete. It is because of the low voltages and currents employed in telephone cables that we have no occasion to fear an electrical breakdown from one cable to another in an adjacent duct, through the butted joint between multiple conduit sections.

With the multiple duct type of construction, as well as that of any other type, it is of course necessary to provide some form of union between longitudinally adjacent sections of conduit, that will maintain the alignment of the ducts and prevent the infiltration of silt and sand from the surrounding soil. It has been the practice in the past, with multiple duct conduit construction, to form the joint with cement mortar. A pat of mortar is first placed on the bottom of the trench where the

joint will fall, a strip of cheesecloth is then wrapped around the conduits at their junction, to prevent mortar entering the ducts, and the joint is completed with mortar applied with a trowel to sides and top. It will be appreciated that the working conditions in a narrow trench are such as to make it difficult to apply the mortar in such a way as always to insure an intimate bond between mortar and tile at all points, or to have any means of checking the results obtained.

When the conduits are new, no difficulty is experienced in installing cables; but several years after the construction of an underground conduit system, the story may be entirely different. As is well recognized, water has a persistent way of working through tiny crevices and carrying with it particles of silt and sand, which are deposited where the flow of water is retarded. In an underground conduit system, over long periods of time, these accumulations are sometimes sufficient to require their removal before new cables can be installed. This may not be a particularly difficult operation, if the deposits are susceptible of removal by some one of a number of tools that can be dragged through the duct line. At times, however, it is impossible to get a line through the duct, from manhole to manhole, without first removing heavy deposits that may be completely blocking the duct. In such cases special tools must be employed on the entering end of jointed duct rods used for threading the ducts, and the process becomes slow and laborious. Of course, the soil conditions in different areas are quite different, and some soils are much more troublesome than others.

In very aggravated cases there may be no alternative but to resort to an excavation of some portion of the conduit run. This involves measuring with duct rods the distance from manhole to obstruction, laying this off on the surface of the ground, digging down to expose the conduit, breaking into it and clearing the obstruction. The conduit must then be repaired and the trench backfilled. This operation often involves in addi-

tion the breaking through and restoration of pavement, which adds considerably to the cost.

Of course, this infiltration of silt and sand could be prevented by providing a heavy monolithic concrete encasement for the conduit, but the expense of this method for general use in telephone practices would be prohibitive.

In studying the development needs of the Bell System, it appeared that, if an improvement could be effected in the type of joint employed with multiple clay conduit construction, appreciable savings could be made in the expense of preparing ducts for the installation of cable. Accordingly, arrangements were made with the Bell Telephone Laboratories to undertake studies with this end in view. It should be pointed out that the proposed objective was silt-proofness rather than waterproofness, in spite of the fact that the exclusion of all water unquestionably would be desirable, since much of the trouble experienced with underground cables is due to moisture reaching the conductors through openings which occasionally develop in the sheath. The objective was limited, however, because it is practically impossible to exclude water entirely from an underground conduit system, since it would be present often as the result of condensation if from no other cause.

The studies undertaken by the Laboratories canvassed the whole field of conduit construction, even to the consideration of materials other than vitrified clay, and to the use of vitrified clay conduit in more complex forms that might appear to facilitate making the joints silt-proof. Obviously, it was desirable that the solution of the problem should be accomplished without having the effect of increasing overall costs, and a number of possible solutions were eliminated on this basis.

One natural suggestion was the employment of some plastic form of material which might be applied with a fabric backing that could be wrapped around the conduit, overlapping the ends of two adjacent sections. Asphaltic compounds of different kinds were tried in this way, with some appearance of promise,

but the results were very erratic and there was no way of determining at the time of construction how satisfactory a joint had been obtained. It developed also, in the case of some of the materials at least, that a rather precise technique was required in the preparation and handling of the material to provide a satisfactory joint even under laboratory conditions.

Previous attempts had been made in the field to mold a mortar collar around the conduit at the junction of adjacent sections, but efforts along this line did not result in fully satisfying the desired objectives.

One of the principal difficulties with all joints seemed to be to secure a proper union between the joining material and the conduit on the under side, where even visual inspection was out of the question. It was recognized that where cement mortar could be properly applied very satisfactory results were obtained, and it appeared that the solution might lie in the method of applying mortar so as to insure an intimate contact with the conduit.

The Bell Telephone Laboratories in following up this idea made some experiments in applying the mortar in the form of a poultice encased in cheesecloth, a method also previously tried unsuccessfully in the field, with the idea that the cheesecloth would assist in applying the mortar and in bringing it into close contact with the conduit, as well as helping to hold it there until set. The first efforts along these lines did not bring satisfactory results, because when a sufficient thickness of mortar was employed to insure adequate strength at the joint, there was encountered a tendency for the mortar to slump in the poultice and to resist any efforts to redistribute it by stroking the outside of the bandage. Then the happy thought suggested itself that an intermediate strip of cheesecloth in the center of the poultice might help matters, and this proved to be the case. A poultice, or to use a more descriptive term a mortar bandage, formed in this way, did not show any tendency for the mortar to slump and permitted the mortar to be worked

FIG. 1. TYPES OF VITRIFIED CLAY CONDUIT USED IN THE TELEPHONE PLANT.

FIG. 2. PARTIAL VIEW OF FIELD LABORATORY AT CHESTER, NEW JERSEY.

FIG. 3. VIEW OF ONE OF THE FLOODING TRENCHES AFTER A TEST.

FIG. 4. MODIFIED STANDARD JOINTS WITH SUPPORTING BASE, AFTER TEST.

FIG. 5. ASPHALT BANDAGE JOINTS AFTER TEST SHOWING WEAKNESS OF STRUCTURE UNSUPPORTED.

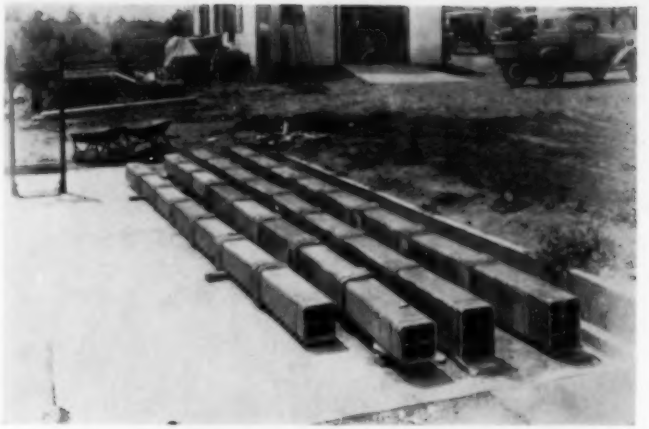


FIG. 6. MORTAR BANDAGE JOINTS AFTER TEST SHOWING STRENGTH UNSUPPORTED BY BASE.

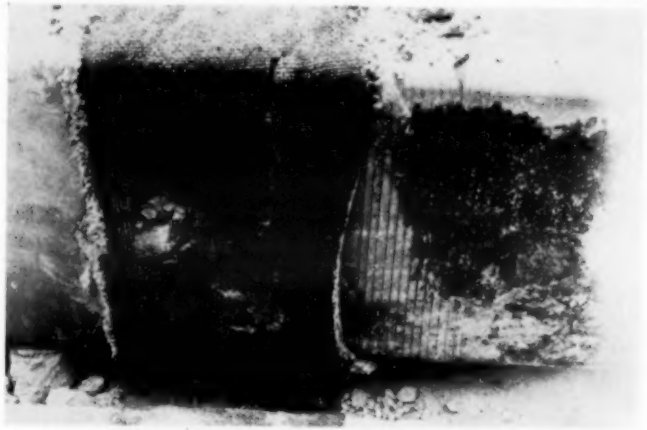


FIG. 7. ASPHALT BANDAGE SHOWING FAILURE OF JOINT FROM EXTERNAL WATER PRESSURE.

FIG. 8. SAME JOINT SHOWN IN FIG. 7 BROKEN OPEN AND SHOWING OBSTRUCTIONS IN DUCT.

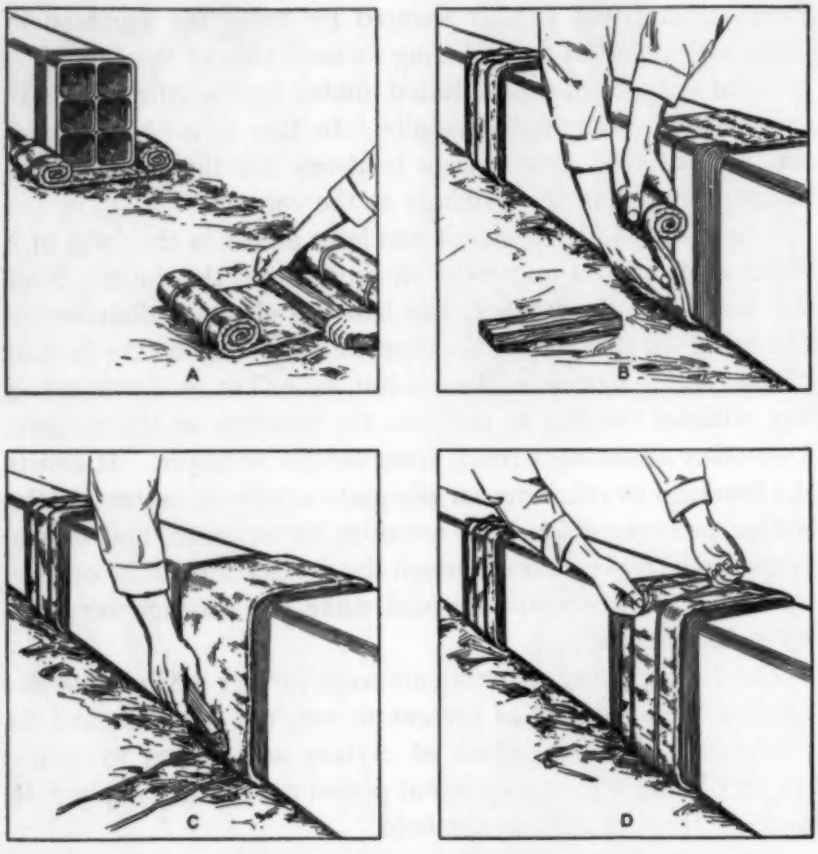
into close contact with the conduit by stroking with a wooden block. Through further experimentation, the proper mesh of cheesecloth and the proper consistency of the mortar were determined, so that when the bandage is applied sufficient cement paste will flood through to insure a firm bond with the conduit. Close contact was further assured by tying the bandage in place with a cotton tape binding on each side of the joint. A joint of this kind, when tested under hydrostatic pressure, showed very encouraging results. In this form, however, it was evident that there was a tendency for the tapes to cut rather deeply into the bandage at the corners.

A substantial improvement was later added in the form of a paper strip, placed under the cheesecloth on the outer side of the bandage. As applied, this had the effect of distributing somewhat the pressure of the tape, thereby securing the desired contact on the bottom of the conduit, as well as on the sides and top, without tending to cut into the bandage at the corners. Two other advantages result from the use of paper. It assists the bandage in retaining an adequate supply of water for the setting process, which is so essential for strength, and it prevents paste from exuding through the cheesecloth on the outside surface, a condition which would make the bandage very disagreeable to handle.

The Laboratories' experiments were further extended to determine the best kind of cement to use, the best mix and its consistency, and the effect of certain admixtures to insure proper plasticity over a sufficient period of time to comply with working requirements in the field.

Part of the Laboratories' investigations and experiments were conducted at their indoor laboratories in New York, and during the progress of development they also supervised certain trial installations in the plants of operating companies. These facilities, however, were inadequate to permit properly conducting all of the experiments deemed necessary. In the first place indoor laboratory methods as applied to underground conduit

construction cannot be made to properly simulate field conditions. On the other hand, due to the pressure attendent upon work in the field, where a large construction force is co-ordinating its efforts in the interest of economy, there is not the oppor-



METHOD OF APPLYING MORTAR BANDAGE.

tunity to stop and study the detailed operations, as is necessary in the development of improvements. Neither is it possible to apply any positive checks or make comparisons as to the results obtained with different methods. For these reasons a field laboratory was recently established near Chester, New

Jersey, laid out on such a scale as to provide conditions essentially similar to those encountered in actual practice. Among other provisions, concrete trenches were built in which conduit runs differently constructed might be tested through the flooding of the trench. (See Figures 2 and 3, facing page 220.)

These trenches were used for comparative tests on conduit joints made by four different methods. In each case a 20-foot length of conduit run was built up, 20 ducts in cross-section, consisting of 2 four-duct multiple units laid on top of 2 six-duct multiple units. In each case a dirt bottom was first laid in the concrete trench, the end sections of conduit were sealed with cement plugs, and one of these in the lower tier of each unit was tapped with a drain pipe extending out through the sealed end of the trench into a manhole where the seepage could be measured. After the laying of the tile and the completion of the joints, the trenches were backfilled with dirt and flooded. The water seeping into the ducts was caught as it emerged from the drain pipes and measured periodically over several months until stable results were obtained. The conduits were then dug out and raised to the surface, where the joints were broken down and examined for defects and the silt deposits studied.

One of the installations was of standard troweled joint construction, laid on a four-inch base of newly placed concrete to provide a firm and even bed for the conduit. Another installation employing a modification of the standard joint was also laid on a similar base, but in this case, in addition to the cheesecloth strip laid next to the conduit overlapping the opening at the junction of adjacent sections, a wider strip of cheesecloth was also employed outside of the mortar, which was applied with a trowel in the usual manner. (See Figure 4, facing page 220.) This outer strip of cheesecloth was drawn around the joint, and a trowel used to press the mortar against the conduit. In addition, the longitudinal joints between the multiple units themselves, and between them and the base, were carefully pointed up so as to make as nearly as possible a waterproof job.

Still another installation involved the use of an asphalt wrapping backed with burlap, the best of its kind as determined by previous experiments. (See Figure 5, facing page 221.) This was laid without a concrete base. The fourth installation employed the mortar bandage and also was placed without a concrete base. The lower units were joined with bandages in which the paper inserts were omitted. The four-duct units in the upper tier were joined with mortar bandages which included the paper strips. (See Figure 6, facing page 221.)

To briefly sum up the results of this comparison, it was found in these experiments that the standard troweled joint was not wholly effective in excluding water and silt. The modified standard joint proved superior to the standard, but still did not effectively seal the joints. The asphaltic wrapping proved to be unstable with a tendency to cold flow under pressure, with the result that the compound in many cases was squeezed in between the ends of the conduits. This not only resulted in openings in the joints but caused obstructions of asphaltic material to be formed in the ducts. Because of the nature of this material, it would be particularly objectionable in a duct line, due to its tendency to increase the friction on a cable being pulled into the duct. The mortar bandage joint without the paper insert, while superior to the other types mentioned, allowed a little leakage in a few of the joints; whereas the four-duct sections, joined with mortar bandages including paper inserts, were practically waterproof. (See Figures 7 and 8, facing page 221, and Figure 9, facing this page.)

The results of these experiments with the mortar bandages were so favorable that it was decided to recommend them for a general field trial throughout the Bell System. To adapt their use to field practice, however, it was necessary first to work out the technique of handling the various steps in the process of making and applying bandages. Cheesecloth, paper and tape, of the kinds found most suitable, were made available, cut to size for conduits of different dimensions; and arrangements

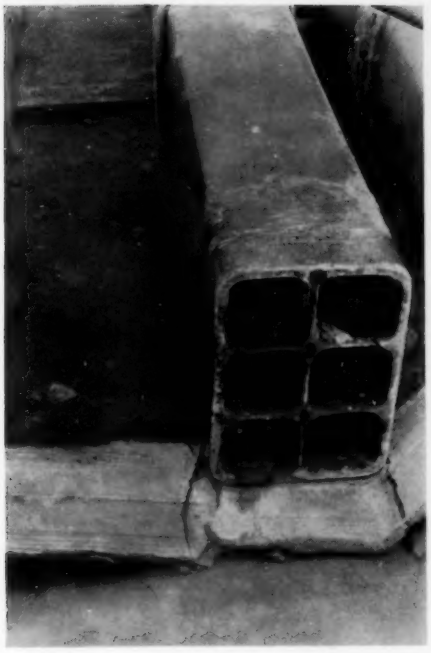


FIG. 9. MORTAR BANDAGE JOINT BROKEN OPEN. INTIMATE CONTACT INDICATED BY SCARIFICATION OF CONDUIT MARKED ON THE BANDAGE.

FIG. 10. WORK BENCH AND TRAYS DESIGNED TO FACILITATE THE MAKING OF MORTAR BANDAGE JOINTS.

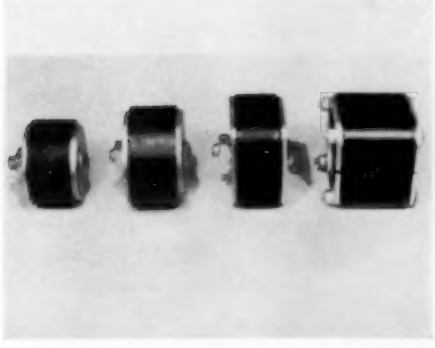


FIG. 11. DUCT PLUGS FOR BOTH EMPTY AND OCCUPIED DUCTS.

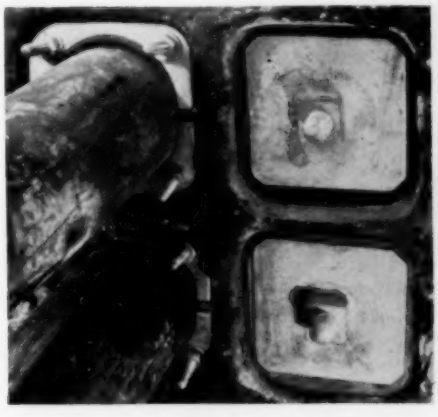


FIG. 12. DUCT PLUGS INSTALLED IN CENTRAL OFFICE VAULT.

were made so that the quantities of these materials necessary to complete a convenient number of joints would be furnished in a single package. A bench design suitable for the manufacture of the bandages had to be worked out, and trays provided in which the bandages could be readily assembled; several sizes of trays of course being required. (See Figure 10, facing page 224.)

It was also necessary to see that a field practice was established that would make use of the technique found to be most efficient in the mixing and testing of the mortar, the fabrication of the bandage, and its application to the conduit. Because the new method was something entirely different from the practice followed in the past, detailed instructions were prepared for the benefit of the conduit forces, outlining all of the essential points in the technique of performing the various operations. To still further facilitate the transmission of these ideas to the workmen actually performing the operations, an educational sound film was prepared, which illustrated and explained every move in the process and in addition demonstrated the unsatisfactory results that would follow certain variations from the procedure recommended.

In considering the benefits which it is expected to derive from the development of the mortar bandage joint, there is of course the saving that is anticipated in the cost of rodding ducts. It is also expected that the Operating Companies will find many cases where they can take advantage of the high strength provided with this form of joint to lay conduits without the concrete base often employed. As an example of the strength of these joints, beam tests, made on a two-duct multiple conduit laid flat and containing three joints, showed that in an unsupported span of six feet it was capable of sustaining a load of 1000 pounds. As affecting construction costs in general, it seems that the bandage joint also offers economies through the speeding up of the subway job, since it permits more rapid completion of those operations which are performed in the trench

and which act as the bottleneck controlling the speed of the job as a whole. Following such operations, the trench may be immediately backfilled on completion of a bandage joint, whereas with a troweled joint the mortar should be allowed to take its initial set before backfilling. It is interesting to note also that the mortar bandage will permit the alignment of the conduit run in the trench without cracking the newly finished joint. This would not be possible with the ordinary troweled joint. The mortar bandage is also peculiarly adapted to the assembly of conduit into those special curved sections often required at central office entrances, or where ducts are splayed at the entrances to manholes. By the use of short sections of vitrified clay conduit, and with the choice of either straight or mitered ends, it is possible with the mortar bandage to build up variously curved sections with no abrupt offsets in the duct line, and to do most of this work above ground, where the working conditions are better.

It was previously pointed out that underground conduit systems could not readily be kept free from water and that, accordingly, in solving the silt problem efforts were not directed especially toward the exclusion of water. There are certain instances, however, where water does become so objectionable as to require special means of excluding it from parts of the conduit system. This is particularly true at central offices, where the entrance of not only water but gas may become quite troublesome at times. In such cases, it has been customary to seal the ducts at the entrance in various ways, none of which have proved entirely satisfactory. In order to solve this problem, arrangements were made with the Bell Telephone Laboratories to undertake its study as a separate project. As the result of their efforts, specially designed rubber duct plugs suitable for both vacant ducts and those occupied with cable have now been made available for field trial, after the initial trials indicated that they appeared in every way to meet the requirements. (See Figures 11 and 12, facing page 224.)

With the mortar bandage joint and the new duct plugs it is expected that it will be now possible to meet all reasonable requirements with respect to silt and gas as encountered in the underground plant of the Bell System and that those requirements with respect to water control outlined above can now be satisfactorily cared for.

A. L. Fox

The Trans-Canada Telephone System

Editor's Note:

The inauguration of the Trans-Canada Telephone System represents a notable achievement in the progress of telephone communication. It is of particular interest to readers of the BELL TELEPHONE QUARTERLY, *not only because the Bell Telephone Company of Canada is one of the seven separate telephone systems co-operating in the enterprise, but also because Bell System standard operating practices and routing instructions, as well as Bell System practices in transmission maintenance work, have been adopted as standard on this all-Canada transcontinental telephone line.*

THE formal opening of the Trans-Canada Telephone System on January 25, 1932, by Lord Bessborough, Governor-General of Canada, signalized the completion of one of the major telephone projects in Canada, a project which has necessitated the attention and co-operation of the seven larger telephone systems in Canada. The Trans-Canada Telephone System provides a group of long haul circuits entirely within the Dominion for the handling of Trans-Canada business. The system was also designed to co-ordinate with the general toll switching plan in the United States. Prior to the inauguration of the Trans-Canada System it was necessary to route the long haul toll business between Canadian points, to a large extent, over lines in the United States.

It is proposed in this article to describe the development of the Trans-Canada Telephone System, including an outline of the many interesting problems in circuit design and construction encountered during the engineering work. A historical sketch of the telephone business in Canada is first presented

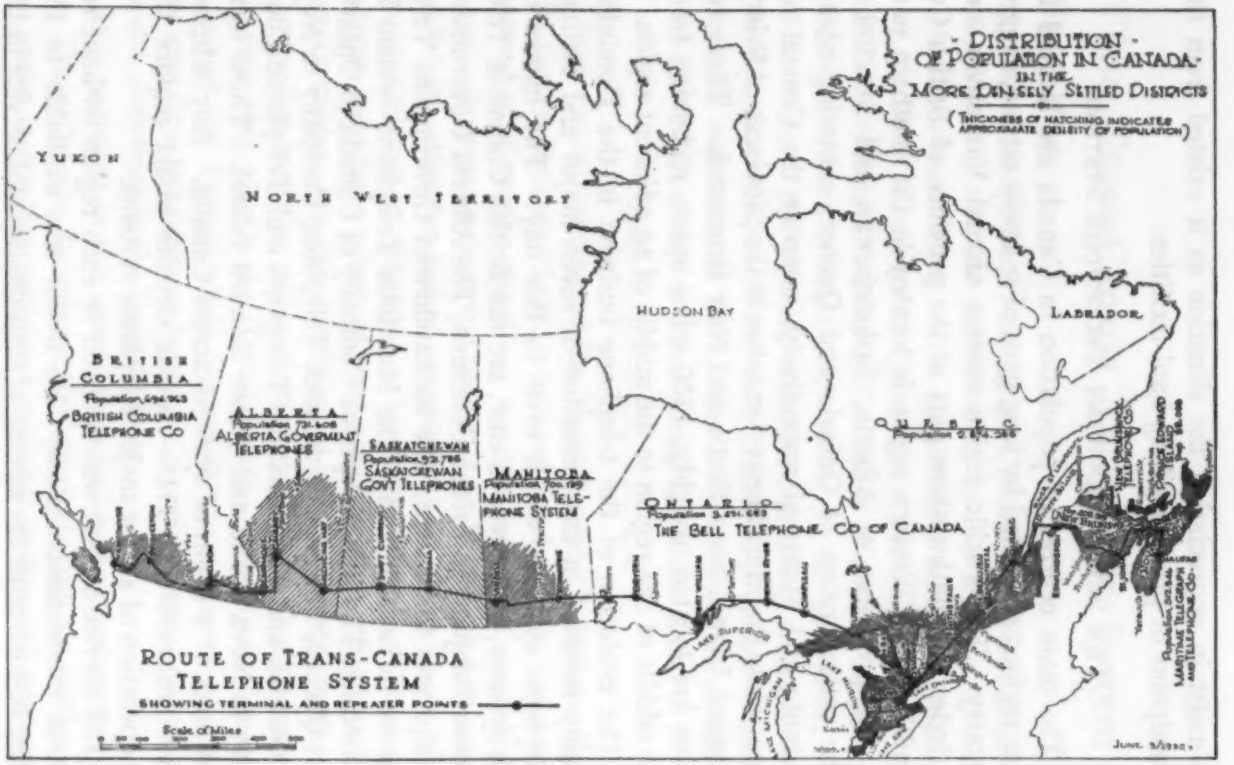
to assist in appreciating the situation as it existed from the standpoint of providing long haul facilities.

The Seven Canadian Telephone Systems

The main centres of population in Canada are located in four regions separated by long gaps of sparsely settled, rugged country. The Pacific region centres around Vancouver and includes the southwestern part of the province of British Columbia. The Western region is located in the southern part of the provinces of Alberta, Saskatchewan and Manitoba. The settled parts of Ontario and Quebec, centering about Toronto and Montreal respectively, compose the Central region, while the Maritime region takes in the provinces of Prince Edward Island, Nova Scotia and New Brunswick. These regions are located, roughly, 1300 miles apart, reckoning from the middle of one region to the middle of an adjacent region.

The evolution of the telephone business in the Dominion finally resulted in the formation of seven major and distinct telephone systems, which exist to this day. The names of the systems, from west to east, are the British Columbia Telephone Company in British Columbia, The Alberta Government Telephones in Alberta, The Saskatchewan Government Telephones in Saskatchewan, The Manitoba Telephone System in Manitoba, The Bell Telephone Company of Canada in Ontario and Quebec, The New Brunswick Telephone Company in New Brunswick and The Maritime Telegraph and Telephone Company in Nova Scotia and Prince Edward Island. These form the links of a chain of systems across Canada. Any scheme, therefore, involving Trans-Canada circuits would require the co-operation of all the major telephone systems.

Toll service at first was confined to each region without regional intercommunication. No outlet was available to the other regions until the advent of transcontinental service in the United States. Connections with the Bell System were established at this time and provided a means of communication be-


- DISTRIBUTION -
OF POPULATION IN CANADA
IN THE
MORE DENSELY SETTLED DISTRICTS
(THICKNESS OF HATCHING INDICATES APPROXIMATE DENSITY OF POPULATION)
YUKON
NORTH WEST TERRITORY
HUDSON BAY
LABRADOR
BRITISH COLUMBIA
Population 694 263
BRITISH COLUMBIA TELEPHONE CO
ALBERTA
Population 731 605
ALBERTA GOVERNMENT TELEPHONES
SASKATCHEWAN
Population 921 785
SASKATCHEWAN GOVT TELEPHONES
MANITOBA
Population 700 139
MANITOBA TELEPHONE SYSTEM
ONTARIO
Population 3 431 683
THE BELL TELEPHONE CO OF CANADA
QUEBEC
Population 2 874 255
NEW BRUNSWICK TELEPHONE CO
PRINCE EDWARD ISLAND TELEPHONE CO
NOVA SCOTIA TELEPHONE CO
MARITIME TELEGRAPH AND TELEPHONE CO
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
ROUTE OF TRANS-CANADA
TELEPHONE SYSTEM
SHOWING TERMINAL AND REPEATER POINTS
Scale of Miles
JUNE 1/1932.

tween different sections of Canada at a time when direct circuits through the Dominion were not economically feasible.

The Telephone Association of Canada

It has already been mentioned that in order to provide service from coast to coast over Canadian lines, it would be necessary to enlist the active co-operation of the different telephone systems across Canada. This and other problems which required the assistance of a number of systems for their solution, resulted in the formation in 1921 of the Telephone Association of Canada. The association is composed of members representing the seven major telephone systems in the Dominion. The purposes of this association are "to protect telephone investment; to establish uniformity of construction, maintenance, operation and accounting; to disseminate useful information; to cultivate cordial relations and to do all things necessary to systematize, unify and render efficient telephone service in the Dominion of Canada."

One of the problems discussed by the Telephone Association of Canada at its first annual meeting, was the provision of Trans-Canada circuits. A committee was formed to investigate the possibility of providing such service. This committee presented its report at the second annual convention held in 1922. The report indicated difficulty in providing telephone facilities in three sections. In the West, the massive ranges of the Rocky Mountains presented a barrier some hundreds of miles in length, which it seemed almost impossible to span with poles and wire, either on roads or private right-of-way, in order to provide service. The only possibility which appeared feasible at that time was the use of one of the railway company's telegraph leads which were constructed on the railway right-of-way.

Between the Western and Central regions, lay a stretch of rocky country extending from Winnipeg to Sudbury, some 1000 miles in length. This country is very sparsely settled

and here again, the only solution appeared to be the use of the railway company's pole lines. The third section, between Quebec and Saint John, required some four hundred miles of pole line through a part of the country practically uninhabited and where pole line construction would be very difficult.

Although further committees were formed at subsequent meetings to report on the Trans-Canada project, it was not until the annual convention in 1928 that it was decided the time was opportune for a complete study of the construction necessary to provide Trans-Canada facilities. At that meeting the Bell Telephone Company of Canada was requested to proceed with an engineering study to determine what additional facilities would be required to make available all-Canadian transcontinental service.

Continued progress was being made by the separate telephone systems in extending toll service in each region and between regions. By 1927 plans had been made to span the three gaps separating the regions and by the end of 1928 telephone circuits were in operation in each gap.

Trans-Canada Reports

The preliminary report was submitted to the Executive Committee of the Telephone Association of Canada in April, 1929, and outlined what progress had been made in the study. This report covered the circuit requirements, an estimate of revenue and some preliminary data on the route, transmission requirements, maintenance requirements and outside plant features.

The final report was presented to the Executive Committee at the annual convention held in September of 1929. One of the more important items covered in the report was an estimate of costs. More complete data were also made available on the pole route, transmission requirements, maintenance features and outside plant features. The reports were adopted at this meeting and it was decided to proceed with the project

at the earliest possible date. Work was started in 1930 on the basis that each telephone system concerned would provide the facilities required in its own territory, thus bearing its share of the total cost.

The project was scheduled for completion in 1932, the circuit requirements being worked out so as to take care of the traffic in that year.

Traffic Data

A large amount of basic data was required before proceeding with the study of the Trans-Canada Telephone System. A questionnaire was therefore prepared requesting this information. Message figures were obtained for a number of years prior to 1929. These figures were used in preparing estimates of messages for the years from 1929 to 1932, which in turn formed a basis for determining the circuit requirements.

Arrangements were also made to obtain quarterly reports of messages for 1929 and subsequent years. These reports were used to make periodic checks of the estimates so that, if necessary, the circuit requirements could be revised.

The circuit layout was made as flexible as possible so that any large deviations from the estimates could be cared for by modifying the circuit layout. The original Trans-Canada study considered twelve circuits but actually only seven circuits were placed in operation.

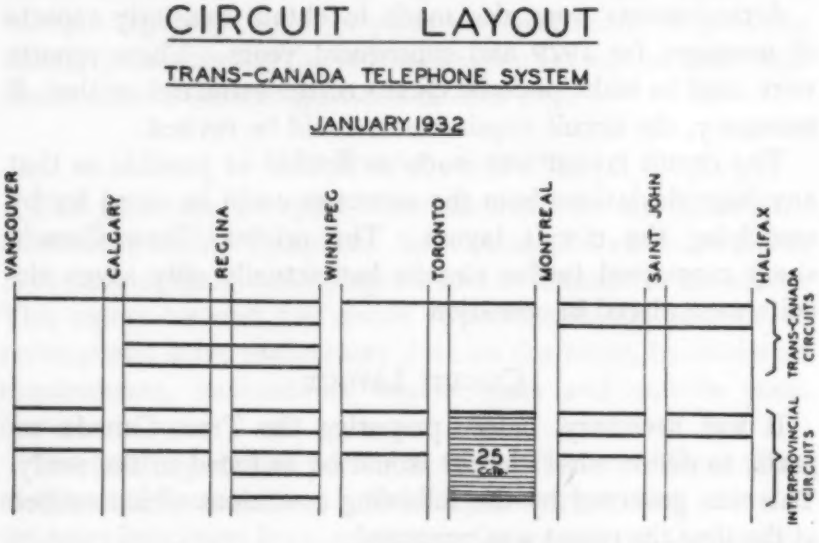
Circuit Layout

It was necessary, before preparing the Trans-Canada reports, to define what circuits would be included in the study. This was governed by the following conditions which existed at the time the report was requested:

By 1927, no through telephone circuits had been established through the Rockies, the district between Sudbury and Winnipeg, and between Quebec and Saint John. However, as previously mentioned, plans were in course of preparation

providing circuits in each of these gaps by the end of 1928. Although the amount of business was still limited it was felt that the provision of direct circuits, and therefore faster service, would soon stimulate further business. Later events proved that these premises were well founded.

In November, 1928, a circuit was established between Calgary and Vancouver, over the Canadian Pacific Railway Company's telegraph pole lines through the Rockies. In August, 1928, Sudbury and Winnipeg were joined together by a direct circuit on the Canadian Pacific Railway Company's telegraph pole line between these points. East of Quebec circuits were erected, partly on connecting company's lines and partly on a new line, and joined the New Brunswick Company's line at Edmundston. Two direct circuits were then made available in December, 1928, between Montreal and Saint John.



At the end of 1928, therefore, circuits were available between all adjacent provinces. These circuits functioned satisfactorily in providing telephone links between adjacent systems, but the two wire voice frequency type of telephone

circuit has certain limitations which become apparent when attempts are made to make use of this type of facility for establishing very long telephone connections. The use of such circuits for long connections would also be unsatisfactory from the standpoint that frequent switches would be required.

In order to provide a suitable grade of transmission between all points in the various regions in Canada, and particularly, for those cases where very long telephone connections are involved, circuits with high inherent transmission stability and good transmission quality are required. As it is not feasible to provide direct circuits between all systems, the circuits must be suitable for interconnection by means of switches, in order to establish built-up connections.

As no specific plans were being made by the individual system to establish circuits between non-adjacent provinces and in view of the transmission requirements for the design of such circuits being more severe than those of much shorter length, it was decided that the Trans-Canada report would specify the circuit requirements between points separated by one or more provinces.

The following table shows the Trans-Canada circuits actually placed in operation and the number of circuit miles operating over carrier and voice frequency facilities.

Group	No. of Circuits Jan. 1932	Length of Group in Miles	Circuit Miles		
			In Carrier	In V. F.	Total
Winnipeg-Vancouver	1	1744	925	819	1744
Winnipeg-Calgary	3	925	1850	925	2775
Winnipeg-Montreal	1	1578	1247	331	1578
Montreal-Halifax	2	890	1244	536	1780
Total			5266	2611	7877

It will be noted that there are four groups of circuits with almost eight thousand circuit miles. About 67 per cent of the total circuit miles is in carrier, the remainder being in voice frequency and consisting mainly of open wire facilities.

In addition to the circuits tabulated above, the Trans-Canada plans embraced other long haul facilities which form an integral part of the project, since they act as main feeders for the Trans-Canada circuits. The more important of these facilities, which are shown below, were built with the Trans-Canada circuits in such cases where they were not already available;—

Group	No. of Ccts. Jan. 1932	Length of Group in Miles
Vancouver-Calgary	3	819
Calgary-Regina	3	507
Regina-Winnipeg	5	418
Winnipeg-Toronto	3	1278
Montreal-Saint John	3	622

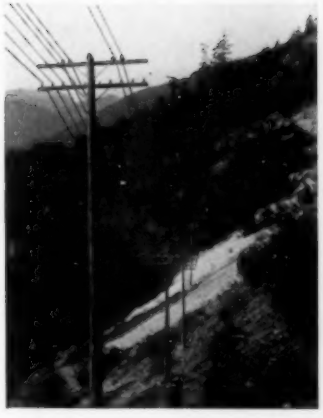
With this circuit layout taken in conjunction with the inter-provincial circuits, not more than two switches are required between any two of the main switching points in Canada.

Pole Route

The choice of a suitable pole route for the Trans-Canada circuits, involved a comprehensive survey of existing facilities. It has already been mentioned that at the time the report was undertaken circuits had been established between all adjacent provinces. The routes followed by these circuits were therefore used as a starting point in the survey.

In general, it was found that the existing routes were suitable or could be made suitable at a smaller cost than any other route, considering at the same time the intermediate requirements. The existing leads take the most direct route between the main switching centres, are comparatively free from power exposures and provide suitable locations for repeater points. Although complete rebuilding was required in many places and major changes necessary at other points the selection of any other route, in general, would have required a new and longer lead.

Two major exceptions were made. In the case of the route through British Columbia it was decided not to use the Cana-



Crossing the Mountains of British Columbia

THE TRANS-CANADA TELEPHONE SYSTEM

Catenary Crossings

Stone-Boat for Stringing Wires

In British Columbia

In Alberta

In British Columbia

dian Pacific Railway Company's lead, but to build a new lead about 150 miles south of the railway. It is expected that the choice of this route will result in improved service and it has the advantage that long lengths of cable are avoided, due to tunnels. Although the new route is nearly two hundred miles longer than the existing route, it passes through a settled district and can therefore be used to take care of circuits to intermediate points.

The other exception was between Brandon and Winnipeg for some 200 miles where it was decided to keep away from the main lead. The new lead is about 40 miles longer, but avoids the necessity of rebuilding an old lead with as many as eight crossarms in certain sections. A long power parallel near Winnipeg is also avoided.

The total length of the pole line is about 4200 miles, of which it was necessary to rebuild completely about 2000 miles and to carry out pole work for carrier transposing for some 1500 miles.

Transmission Design Features

The transmission requirements for the Trans-Canada circuits were engineered on the basis of meeting the limits recommended for the general toll switching plan. In view of the length of the Trans-Canada circuits many interesting transmission problems arose which are not normally encountered in designing the shorter haul facilities.

Transmission design requirements in respect to transmission equivalent, noise, crosstalk and distortion for both direct and switched connections indicated the desirability of restricting the length of the voice frequency circuits and using carrier systems for the longer circuits.

To obtain suitable transmission results it was necessary to provide the best available grade of outside plant facilities consisting of 165 copper wire on CS insulators at 8″ spacing. The use of 165 copper on CS insulators has the advantage of lower

attenuation and of greater stability compared to the use of smaller gauge wire on ordinary toll insulators. With the larger gauge wire the fluctuations of equivalent are less with temperature and humidity changes. The improved glass insulators, moreover, effect a marked reduction in attenuation and in the variation of attenuation with weather conditions. Eight-inch spaced non-phantomed facilities were required in order to meet the cross-talk design limits for circuits of the type and length involved in the Trans-Canada System.

Certain limitations are imposed upon the number of carrier systems which can be operated in tandem. This resulted in the use of voice frequency facilities in a few cases where carrier was available. It is interesting to note the extent to which carrier was used; as previously noted, about 67 per cent of the circuit miles is in carrier.

The repeater points shown on the Trans-Canada route map have been so spaced that advantage is taken of the possibilities of the large gauge wire when erected on improved glass insulators at 8″ spacing.

Where carrier is involved line filters with a cut-off frequency of 5000 cycles have been used so that the circuits may be available for the transmission of programs when required.

In addition to the regular facilities, emergency assignments have been provided to take care of the carrier systems when failure occurs on the regular assignment. The emergency facilities are, in many cases, inferior to the regular assignment and in the design work, it was necessary to co-ordinate the carrier and voice frequency repeater points, both for the regular and emergency assignments of the carrier.

A 2-A automatic pilot channel regulator is now being installed on the Oshawa-Winnipeg carrier system (about 1250 miles), while the Calgary-Winnipeg system (about 925 miles) is already equipped. This regulator equipment will further improve the stability of the circuits. A number of observations made on the Oshawa-Winnipeg carrier system when

equipped with the 1-A pilot channel showed that under certain conditions large variations amounting to as much as 13 or 14 db occurred between the hourly reading. With the 2-A system these variations will be compensated for automatically.

Outside Plant Construction

The major portion of the outside plant consists of open wire construction. Short toll entrance cables exist at repeater and terminal points, the total length amounting to about one per cent of the length of the pole line. There are two sections of toll cable, totaling 78 miles in length. One section of 34 miles is located between Toronto and Oshawa, the other section, 44 miles in length, is between De Beaujeu and Montreal.

In view of the importance of the Trans-Canada circuits, the number of circuits superposed on each open wire pair and the absence of alternate routes through Canada for over three quarters of the length of the line, careful consideration was given to the choice of open wire facilities. Copper line wire 165 mils in diameter is provided for a large part of the distance. This gauge has the advantage of greater mechanical strength and therefore more freedom from storm damage and other circuit troubles, compared to the lighter wire gauges.

It has already been pointed out that for transmission reasons it was decided to place the line wires at eight-inch spacing. This type of construction required a new system of transpositions in place of that which had hitherto been used. K-8 transpositions have been installed in the section between Winnipeg and Vancouver, and k-8 and k-10 transpositions in about half the line between Winnipeg and Halifax, the remainder being voice frequency or alternate arm transpositions.

The pole line was built to Class 1 requirements for heavy storm loaded areas. This provides the highest grade of pole line normally constructed for telephone purposes. For any new construction or reconstruction work western cedar poles

were used west of Winnipeg and creosoted pine for pole work east of Winnipeg.

All toll entrance and intermediate cables have been carrier loaded suitable for the operation of "C" carrier telephone systems. As no loading system had been developed for eight-inch spaced conductors, it was necessary to modify the C4.1 and C4.8 systems to obtain the proper characteristics.

All joints on the open wire circuits used for carrier were soldered so as to reduce the possibility of high resistance unbalances. Transpositions were formed on the point side transposition bracket.

Transmission Maintenance

The maintenance of the Trans-Canada circuits has been the subject of careful study on account of the special conditions existing in Canada. It was appreciated that the maintenance of very long telephone circuits, in such a way as not to exceed the transmission variations contemplated in the design, would be far more difficult than the maintenance of the shorter circuits with which the different telephone systems in Canada had become familiar. Such difficulties were aggravated due to the fact that seven separate systems were involved, each system having, in general, different testing methods.

In order to co-ordinate the maintenance efforts and to assure the highest degree of efficiency and co-operation, so that satisfactory transmission could be maintained with a minimum of lost circuit time, suitable procedures and arrangements were adopted. The principal items in the plan are organization, intercommunicating facilities, instruction of maintenance personnel and the adoption of uniform transmission maintenance practices and testing equipment.

Each circuit in the system has a circuit control office located at one end, which is responsible for the satisfactory maintenance of the overall circuit or speech path, as distinguished from the physical plant required to provide it. The facilities

themselves are divided into units with an office at one end responsible for the maintenance work on the toll plant within the limits of its section length. The unit may be made up of open wire, cable or carrier facilities, with or without intermediate repeaters. If there are intermediate repeater offices, they are assigned the responsibility of maintaining, under the direction of the circuit unit control office, a section of the unit. An organization of this type simplifies the maintenance problems and has the advantage of concentrating the supervisory personnel at a limited number of points.

The necessity for uniformity in the transmission maintenance work was clearly recognized. A special instruction course was held, at which the operating personnel was suitably trained in an understanding of their responsibilities and in the uniform interpretation and application of maintance practices. The Trans-Canada Telephone System adopted the standard practices of the Bell System in the United States for use in the transmission maintenance work, and these practices formed a basis for the instruction work at the course. Arrangements have been made to ensure that the transmission maintenance work is receiving uniform treatment throughout the system.

In order to provide suitable means for quickly testing the lines and apparatus, standard testing equipment has been provided at all repeater points and terminals, consisting of No. 5 toll test boards or their equivalent and 7-A or 7-B transmission test boards. In addition, portable testing equipment is located at strategic points and is used where it is necessary to make tests in the field.

As a check on how the maintenance work is being carried out, monthly reports of trouble are sent to the Chairman for all of the Trans-Canada circuits.

Organization

It was evident that an organization would be required to supervise and co-ordinate the work of constructing, maintaining and operating the Trans-Canada System. At a meeting of the Executive Committee of the Telephone Association of Canada, held in 1931, a Management Committee was formed. In addition to the Management Committee, there are several functional committees responsible to the chairman of the Management Committee. These committees maintain contact with all branches of telephone operation. Under the Management Committee a clearing house is operated which receives reports of Trans-Canada revenue and sees that it is properly apportioned between systems and the necessary settlements carried out. This saves the necessity of each telephone system having to effect separate settlements with all other systems.

Some of the more important work carried out by the functional committees might be mentioned. The adoption of Bell System standard operating practices and routing instructions has necessitated supplying all the systems with sufficient information to place these practices and instructions in effect. Basic traffic records are being maintained for use in determining circuit requirements. Service results have been checked in certain specific cases and it is expected to develop reports which will indicate the service results on a periodic basis.

Standard maintenance practices are now in effect. These practices are kept up to date and are supplemented from time to time to take care of special or local conditions. Service results are checked on a monthly basis by means of trouble reports which are prepared for all Trans-Canada circuits and some of the longer interprovincial circuits. New circuits and changes in existing circuits are authorized by circuit orders and the detailed make-up of the circuit is covered by circuit layout cards. The original transmission design work of the Trans-Canada Telephone System, the scheduling of construc-

tion work and the preparation of studies depending upon special requirements, have been some of the main functions of the Engineering Committee. The engineering of plant extensions requires periodic reviews of circuit requirements and the determination of the best method by which facilities can be provided to take care of such requirements.

Conclusion

The Trans-Canada Telephone System has progressed, from an embryo stage some ten years ago, to an actuality on January 25, 1932. The engineering and construction work has engaged the attention of the committees of the Trans-Canada System for the last three years. Results are now available for about three months' operation and these have been up to expectations. Excellent transmission has been demonstrated on the longest connections in Canada. The same close co-operation in the future which has been exhibited in the past between the major telephone systems in Canada would appear to assure the continued success of the Trans-Canada System.

Sydney Bonneville

The Western Electric Company as a Distributor to the Bell System

EVERY individual is a consumer, but the goods he consumes have usually been produced some distance from the point of consumption. For instance, a simple breakfast for an average family will probably include fruit from California, toast made from Minneapolis flour, bacon from Chicago, sugar from Cuba and coffee from Brazil. Production has in the main congregated in large metropolitan centers, and goods must be transported one or more times before they reach the consumer.

The general work of gathering commodities from world wide points, assorting, grading, selling, packing, shipping, transporting and storing until they are ready for the consumer in his own neighborhood, is commonly known as distribution.

Criticism has frequently been leveled at our modern distribution system because it sometimes happens that the cost of distribution is more than that of the goods distributed. Efforts have been made to eliminate the long string of so-called middlemen, but if goods are to be available to the consumer in his own vicinity, some one must accumulate them, assume the risk of deterioration and loss, carry investment, store, sell, extend credit, pack and ship the merchandise. Our experience in this country seems to prove that these functions can best be performed by people specializing in them, and manufacturers have usually found it desirable to let wholesalers perform this service. Regardless of whether these functions are assumed by the manufacturer, jobber or chain store, no way of eliminating the operations has yet been found and they remain a substantial element in the cost of living. According to the last census, one-eighth of all the people gainfully employed in the United States were engaged in wholesale and retail distribution.

The Bell System is a large consumer of merchandise. The maintenance and extension of its plant throughout the United States requires the use of tens of thousands of different articles. The problem of assembling in the proper place the wide variety of material required by the System does not differ materially from the general problem of distribution. It does differ from the general custom, however, in that through the distribution branch of the Western Electric Company, the Bell System has developed its own wholesaler which does for the System the work of the so-called middlemen.

This unusual arrangement came into being with the development of the supply contract between the operating telephone companies and the Western Electric Company. Under this contract the Western Electric Company agrees to manufacture or purchase material which the telephone company may reasonably require for its business, and to maintain distributing storerooms at points mutually agreed upon; also to receive, store, repair and reissue or otherwise dispose of, surplus material which has been removed from plant. This system was started in 1901 with the signing of the first supply contract by the Bell Telephone Company of Philadelphia (now the Bell Telephone Company of Pennsylvania), and was rapidly developed until at present there are distributing houses in thirty-two of the principal cities in the United States serving all the operating units of the Bell System.

Through these houses and the general departments with which their activities are co-ordinated, the Western Electric Company exercises all functions of the wholesaler; i.e., future demands are estimated, requirements are combined, contracts are made with suppliers for the amount of material required, or production in its own shops is authorized. The Distributing Houses purchase, store, carry investment, sell, extend credit, pack and ship as required by their customers. They carry in stock a large assortment of merchandise, including apparatus, cable and small switchboards of Western Electric manufacture;

wire, strand, crossarms, pole line hardware, electrical supplies, tools, paints, oils, janitor supplies, stationery and office supplies and numerous items of wide variety, even to china for restaurant use and a limited stock of medical and first aid supplies.

The plan whereby a number of separate corporations which collectively comprise a System in effect own their own wholesale source of supply is unusual, and has many advantages. By means of this arrangement the demands of all the companies comprising the Bell System are combined and purchased through a single purchasing agent, thereby securing the advantage of quantity purchases with a minimum purchasing expense.

The business is obtained without the maintenance of expensive selling organization and, since the customer's credit is established, there is no expense for a credit and collection department and no losses from bad debts.

For these reasons the Western Electric Company is free to devote its attention mainly to the control and adjustment of production and to refinement in methods and management, rather than to the usual problem of making sales. Since the corporations comprising the System could not individually get these advantages for themselves, the development of a Bell System distributor is clearly of economic advantage to the telephone companies and, assists them materially in their efforts to provide "the best possible service at the lowest possible cost."

The distributing system consists of general warehouses at Chicago, Ill., Kearny, N. J., and Baltimore, Md.; and distributing houses and repair shops in the following cities: Boston, New Haven, New York, Brooklyn, Newark, Philadelphia, Pittsburgh, Washington, Atlanta, Louisville, New Orleans, Jacksonville, Detroit, Cleveland, Cincinnati, Indianapolis, Chicago, Milwaukee, St. Louis, Kansas City, Oklahoma City, Dallas,

Houston, Omaha, Minneapolis, Des Moines, Denver, Salt Lake City, San Francisco, Los Angeles, Seattle and Portland, Oregon.

The general warehouses located at the manufacturing plants are known as merchandise departments. They receive, pack, store and ship the products manufactured at those plants and conduct all commercial transactions incidental thereto. During the year 1931 the value of the goods sold by these departments averaged $670,000 per working day. In 1930 the corresponding figure was $855,000, and in 1929 it was in excess of $900,000 per working day. The packing and physical handling of merchandise in such quantities is an industrial operation of considerable magnitude, and has been the subject of engineering studies of broad scope. As a result of these studies, material handling equipment has been developed and storage buildings have been designed to fit the particular needs of the business.

The packing, physical handling and storage processes were analyzed in minute detail before the new warehouse recently completed at Kearny was designed. Equipment especially suited to the products was planned, and finally a building to house that particular equipment was erected. Since the products of the shops vary in size from small parts weighing a few ounces to articles which, when crated, weigh several thousand pounds, special equipment and special buildings greatly facilitate the movement of merchandise.

The systems installed are designed so that as material comes from the shop it is placed on moving conveyors, packed while in motion, as far as practicable, and transported to its proper place for storage without having been removed from the conveying system. The same system also takes outbound material by continuous moving processes from storage locations to checkers, packers, shippers, freight cars or motor trucks.

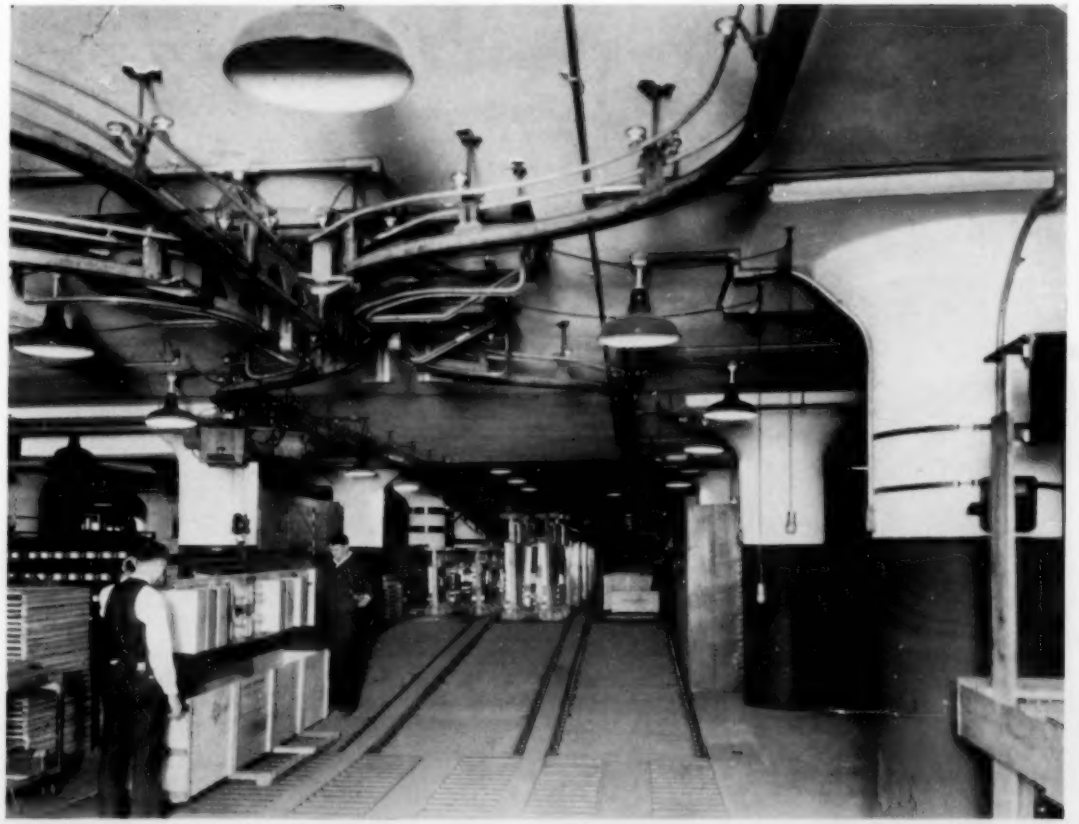
The Kearny warehouse is in two parts. One, a multi-story section with relatively low ceilings for the storage of material packed in small containers which can be economically handled

on conveyors. The other, a special section with a ceiling height of approximately 50 feet, designed for operation with large cranes. Heavy and bulky material, piled to a height of approximately 35 feet, is stored in this section. The handling from conveyor to storage and from storage to freight car is done by electric cranes.

The packing department includes special machinery for cutting packing material to size, multiple nailing machines for the manufacture of cases, automatic sealing machines for cartons, and numerous other devices for reducing packing costs. Packing developments include also a study of packing materials and the standardization of material and methods best suited to the particular product. These studies on cartons and containers have reduced packing costs by more than $1,300,000 during the last five years. Fundamental studies are constantly being made to determine the quantities to be packed in both preliminary and final containers, so that the product may be moved through to ultimate destination at minimum expense from the System's standpoint.

In addition to the general range of commercial activities, a very important function of the merchandise departments is the scheduling of the factory output and its distribution among the various customers, so that the plans of the operating companies and of the Installation Department of the Western Electric Company will be co-ordinated.

The functions of the distributing houses are to receive the Telephone Companies' orders for merchandise, to see that the material is delivered when and where it is wanted, to carry on the commercial functions incidental to the purchase and sale of commodities and, through the distributing house shops, to repair and make available for reuse, material which has been temporarily removed from the telephone companies' plant. For various reasons, such as moves or changes in layout by subscribers, discontinuance of service, new developments and many other causes, apparatus is continually removed from



VIEW AT ENTRANCE OF NEW MERCHANDISE WAREHOUSE, KEARNY, N. J.
Illustration shows material as it is received from the shop, starting along the packing conveyors.

VIEW IN WAREHOUSE AT KEARNY, N. J., showing storage under cranes in building specially designed for that purpose.

plant. To facilitate the economical disposal and repair of such material, a properly equipped repair shop is a part of each house. When material is removed from plant and returned to the distributing house it is carefully examined, tested and classified, and that which can be repaired and for which there is demand is reconditioned and made available for reuse.

In general, the operating requirements which the repaired article must meet are furnished by the Bell Telephone Laboratories. Requirements on finish and appearance are usually specified by the Telephone Company. Constant studies by staff engineers, in co-operation with the shops, the Bell Telephone Laboratories, the American Telephone and Telegraph Company and Associated Companies, have resulted in the development of a standard technique for all shops. Machinery, tools and operating procedures are developed and standardized by a branch of the Sales Engineering Department which also supplies specifications and working instructions in practical form. The entire product is subjected to exacting inspection by skilled mechanics and the work is periodically checked by experts to insure complete compliance with the high standards of the company and the System.

Ordinarily, the object of a distributor is to make money, and the degree of accomplishment is shown by the rate of return on the capital invested. While it is important that the Western Electric Company's distributing business earn a reasonable return, the objective is not primarily to make money, but to have available when needed the material required by the Bell System for carrying on its operations.

Since the degree of accomplishment of such a purpose can not be measured by the rate of net return, it is necessary to have other means of determining the extent to which this function is fulfilled. This information is secured in various ways. The distributing houses are more than mere warehouses, they are contact points between the Western Electric Company and the telephone companies, and it is the duty of the managers

to familiarize themselves with the telephone companies' problems and to have knowledge of their plans, as though they themselves were a part of the telephone company. It is their duty, also, to inform the operating companies as to what can be expected in the way of delivery, so that the plans of the latter can be intelligently made and carried out with the minimum of interruption.

Central office and large construction projects are co-ordinated from inception by what is known as the questionnaire system, whereby the plans of all departments affected are co-ordinated with the production schedules at the factory.

Ordinary daily deliveries from warehouse stock are coming to be more and more on pre-determined schedules established by the customers themselves. In most cases the telephone company's main garage is located immediately adjacent to the warehouse, and deliveries are made daily in accordance with the particular plan of distribution which the telephone company has in effect for deliveries in metropolitan areas. Under the Bell System plan for metropolitan distribution the service is practically immediate. It would be immediate if Western Electric stocks were never exhausted. Unfortunately, however, there are peaks in demand or delays in securing material which temporarily cause a shortage. Our experience has been that by diligent effort we can confine such shortages to a number not exceeding ¾ of 1 per cent of the items carried and we have, therefore, established as a standard that 99¼ per cent of the items carried in stock shall be on hand available for delivery at all times. Records are maintained so that those in charge of merchandising operations at the houses can at any moment check the actual performance against the standard.

When projects, additions or operations not on the questionnaire basis are to be started by the telephone companies, it is imperative that the material be available as needed or the work can not proceed. A shortage of material would have the same detrimental effect as shortage of workmen. Obviously, how-

ever, if material is made available at great expense or at unnecessarily large investment in merchandise, the cost of the material will be substantially increased, due to high cost of distribution. Good management, therefore, requires that service to customers, distribution expense and merchandise investment be continuously kept in proper relation to each other.

The correlation of these elements of the business has been the subject of much study and has resulted in two developments, viz., Standard Ordering Formulæ and the Bell System Quarterly Forecasting Plan. Each purchase of merchandise sets in motion a chain of operations, such as the determination of the proper amount to buy, the preparation and mailing of the actual order, inspection and transportation of material, its receipt and physical handling into storage, the making of reports and records, the approval and payment of invoice from supplier, etc. Each of these operations adds in some measure to distribution expense. If articles of small value are purchased too frequently, expense is incurred unnecessarily. On the other hand, carrying charges on merchandise are conservatively estimated at an annual cost of not less than 10 per cent of the value of the material, so that unnecessary expense is also incurred by needlessly large investment. Good merchandising, therefore, requires that the quantity specified on each purchase be determined by the relation between expense and carrying charges.

This has been the subject of engineering studies and formulæ have been published so that in each case the quantity of material which will cause the smallest sum total of expense and carrying charges can be readily determined. These formulæ show that the quantities purchased at a single time should be sufficient to last from a week to a year, depending on the movement and value of the article. The application of these formulæ at a typical house to each item in the normal assortment of high and low value items that comprise the merchandise in-

vestment showed that an investment equal to 47 days' sales from stock was the most economical quantity that could be carried. When a stock is once adjusted to the proper amount the merchandise investment can not be reduced further without loss, unless operating expenses are reduced simultaneously. There is, therefore, a necessity for unremitting attention to these problems. It should be noted in passing that control of merchandise investment can be had only by constant study by specialists, as stocks are based on estimated demands from a single customer and if the demands happen to be less than expected there is no other outlet—stocks can not be moved by bargain sales.

The Bell System Quarterly Forecasting Plan is a major effort to solve the service problem and reduce the cost of material. In brief, it is a plan for determining in advance the quantities of material which the System will require for carrying on its operations. Its foundation is the forecasting of demands for a relatively small number of principal items based on construction programs. It includes also the development of mathematical tables to show ratios of associated items of lesser importance to the principal items, and the development of what might be called experience tables which show the relation between many items of material and some factor of the business which causes their usage. The value of such a plan will be obvious from consideration of the following sequence of events.

Before material can be delivered operations must be financed, raw material secured, plant and machinery provided, workmen employed and trained, goods must be manufactured and transported to the points where needed. No deliveries can be made until all these processes have been completed. However, several months are required to complete these processes and when they are started the quantities that will be needed are not known—they must be estimated. If the estimates are too low, sufficient material will not be available. The shortage may be considerable and must be made up by

WESTERN ELECTRIC CO. DISTRIBUTING HOUSE, BOSTON, MASS.

View Showing Mechanical Equipment Used in Packing Department in the Hawthorne Warehouse.

manufacturing on an emergency or overtime basis at higher cost, or construction costs will be increased due to delay and changes in plans. Allocating that which is available causes additional expense and shipment by express frequently adds further to the charges. If the estimates are too high, surplus merchandise probably worth millions of dollars must be carried and stored. This expense is usually incurred by the manufacturer, but the carrying charges must sooner or later be absorbed in the cost of the article.

This development offers far-reaching possibilities for reduction in costs. For example, the houses have in stock a quantity of merchandise estimated to last approximately 50 days. If these stocks could be reduced to 49 days, or by a single day's usage, capital to the extent of $150,000 would be released for other purposes. A similar amount of capital would be released for every additional day's supply of merchandise that could be eliminated, but this is only at the houses. Basic stocks on hand at manufacturing sources are several times larger than operating stocks at distributing houses; so that if by more accurate knowledge of future requirements the quantity on hand is reduced by only a few days' supply, a very substantial amount of capital would be released for other uses.

In addition to its effect on service and investment, more accurate knowledge of demand will reduce first cost of the product itself, not only by reduction of emergency and overtime operations, but by the carrying on of the manufacturing operations on a more even schedule, thus reducing expense by avoiding frequent starting, stopping, changing from one product to another, turnover of workers, etc. The Bell System Forecasting Plan is the most fundamental and systematic effort that has yet been made to co-ordinate demand, production and distribution of merchandise for the Bell System.

The general subject of distribution expense is under continuous study. Since the functions performed are identical at all locations, studies and conclusions, when reached, are ap-

plicable to all. All the operations performed at the distributing houses have been studied in detail with three points in view; first, to see if any operations could be eliminated; second, to see if those which remained could be simplified; and third, to see if they could be performed by mechanical means.

Operating expenses at distributing houses are systematically studied and compared. The competition and rivalry arising from these comparisons has been the source of many improvements in methods and has produced economical results. The output of about 70 per cent of the employees at distributing houses is measured by a Standard Measurement Plan.

When new methods are originated they are usually tried at one location and development completed in actual use. When perfected they are introduced at all locations. Each distributing house is periodically inspected to insure that the quality of work conforms to the company's standard, that approved methods are followed, and that current rates of operating expenses are satisfactory. The routines, forms and equipment used at distributing houses have been standardized, so that when a change or improvement is made it can be introduced simultaneously at all locations.

During the past ten years the sales to companies comprising the Bell System have averaged $250,000,000 annually. A business of this magnitude, carried on in many separate cities throughout the United States, requires administrative methods developed for the peculiar nature of the business. In addition to those checks and tests which determine the extent to which the Western Electric Company fulfills its service functions, it is also necessary to have information showing the condition of the business at all times from an administration and financial point of view. Among other things, the volume of the business by the principal classifications of merchandise must be available; also exact knowledge of operating expenses divided into more than twenty classifications. The capital invested must be analyzed between merchandise, receivables, plant, cash and

payables and, for purposes of control, the length of time the merchandise investment will last, or number of day's stock on hand, must be computed.

These factors are woven into an operating plan in the following manner: The probable sales for the following year are estimated in November, the estimates being based on the plans of the operating telephone companies. These estimates become the basis of an annual budget which includes the factors enumerated above. The budgets are carefully studied from all administrative angles and when approved constitute a master working plan. Reports are made monthly by each distributing house on forms similar to the budgets, and these monthly reports show where each house stands in the execution of the plan. By means of this system the business is always under control, though operations are carried on in many locations.

During the ten years prior to 1931 the growth was very rapid and caused many of the distributing houses to outgrow the premises in which they were located; consequently during that period it was necessary to provide entirely new buildings for the operation of distributing houses in eighteen different cities. In each case the buildings were designed to furnish good working conditions for employees, to provide for the particular needs of the business as developed by operating experience over a long period of years, and to be in keeping with their environment and the high standards of the Bell System.

In conclusion, it is worthy of note that this business is conducted by the distributor for the consumer. It has no viewpoint except the consumer's, and no policy except what is best for its customers. Although the business is obtained without competition, efforts to make distribution better and cheaper have been unceasing. While accurate costs among the wholesale trades are difficult to obtain, those that are available show that the Western Electric Company distribution costs are among the very lowest in the nation.

W. H. GRAHAM

Budgets and Budgetary Control

An address delivered at the Annual Joint Meeting, sponsored by the Baltimore Chapter of the National Association of Cost Accountants and associated organizations, Baltimore, Md., March 22, 1932

WHEN our first parents were expelled from the Garden of Eden, they were told that "in the sweat of thy face shalt thou eat bread." Since then planning and provision for the future have been essential to the existence of the human race. Our best test of this is that the principle of evolution which we term the survival of the fittest has operated to remove speedily from the scene of action those individuals and tribes who took no thought for tomorrow and felt no responsibility for providing against future needs. At the same time, history records interesting examples of planning and foresight. We have the account of Joseph with his dream of seven lean cattle which devoured seven fat cattle—a dream which warned of famine to come and was heeded, with the result that the people stored up grain in the years of good harvests which tided them over the time of scarcity which followed. In these early stories, warnings as to the future came from dreams, from the utterance of oracles, or from other sources little more dependable. Prognosticators of business conditions and economic experts with their art were yet to come. Yet forecasts of our ancient ancestors, particularly when these were based upon sound interpretations of natural law and hard experience, were in some cases realized as is true today.

The period through which we are passing, characterized as it is by grave disturbances in economic conditions not only in the United States but throughout the entire world, has stirred many minds to search for the fundamental causes which have brought

about such widespread maladjustment. It has also led many to search and to prescribe remedies therefor; remedies, some worse than our troubles, designed, if not to prevent entirely the wide swings between prosperity and depression hitherto characterizing the business cycle, at least to diminish their amplitude.

The problems both of diagnosis and of remedies are exceedingly complex. Many factors have contributed to bring about the present depression—the World War, our emphasis of production without the same emphasis on the problems of distribution and consumption, credit abuse, and so on—and even if we ever could reach a general agreement as to the real causes, it would be difficult to appraise their relative importance. In some cases it would not be easy to say with certainty what is cause and what is effect, and probably it is too much to expect the Master Builder to endow this generation with sufficient wisdom to solve all of the problems which now perplex us. Nevertheless, fallible and limited as we are, out of the serious study which is being given to correct our present troubles we shall make progress and some ideas of practical value will emerge to lift our economic order to higher levels.

In the literature which has so far appeared probably no single thought is expressed more frequently than the plea for more systematic and definite planning of our industrial and economic processes. On all sides there are suggestions and demands for forward programming to the end that the operation of business may be kept on a more even keel. As to just how this is to be done and the extent to which it should be carried, there is again no general agreement. We see it developed perhaps to its fullest extent in Soviet Russia where, proceeding from a revolution which broke down the existing economic order, an effort is under way to build a system in which all industrial and economic planning are functions of the State. Few indeed are the responsible Americans who would countenance a system so remote from our policy of individual liberty and initiative and the laissez faire

policy on which our own economic progress has been based. There are, however, many outstanding business leaders as well as economists who believe that we must find means for more effective stabilization of industry and who are confident that more co-operative planning through trade associations, conferences of business leaders, national advisory boards, and particularly through industrial self-control, may be undertaken in ways which will be entirely consistent with the ideals of individualism which have always characterized our thought. Doubtless the only lasting solution to our problems must come from within our social, economic and industrial order. We have been too prone to pass our puzzling problems to government for political solution, or solution by mandate, yet no government is wiser than its people.

I have referred to these fundamental problems of our industrial and social order only because they seem to indicate clearly that the world today, perhaps more than ever before, has become concerned with the general subject of planning and programming, particularly in industry, and certainly within the limits of a particular business enterprise forecasting and budgeting offer the most effective means which have been devised for bringing about co-ordination of activity.

Again, the difficulties which we are now facing may well bring about re-examination of our methods of forecasting and planning. We are having impressed upon us through experience which has too often been bitter, the truth contained in an ancient saying—"No man liveth to himself alone." What man, what business, or even what nation is not at the present time affected in some measure by world conditions entirely beyond any single control. The moral to be derived from this experience seems clear. No business enterprise can safely chart its own course without at the same time giving most careful consideration to the probable effects of the currents and tides of general business which it is likely to encounter. Programs must be developed in the light not only of experience and

prospects within the enterprise itself, but also from the viewpoint of the probable tendencies of those external factors which will affect future progress. To be sure, it is not always easy to determine the course of these factors, but to ignore them is folly. Such external data should be available in the formulation of judgments on which programs are to be based.

Briefly then, we have two general considerations in connection with business forecasting and planning which seem to be especially emphasized by the conditions of today—First, industry must in one way or another develop for itself, and from within, more definite methods of planning and programming its activities, and Second, consideration must be given to the probable trends of general business activity and more especially of those external factors which are most directly related to the activities of the particular enterprise concerned.

Turning now to the more specific phases of the subject of budgeting and budget control, let me state that I speak from experience gathered in the main in the telephone industry and I recognize that the problems of the telephone business differ somewhat at least from those of the ordinary unregulated business. I believe, however, that the philosophy which underlies our practices is sound in theory and is applicable to the broader field of budgetary practice.

What is "budgeting"? Is it as many regard it, a species of "black magic"? No, the undertaking is in no way mysterious. It is primarily the preparation of an overall management program through which the proposed future activities of an enterprise may be correlated and translated into terms of the income statement and balance sheet. The term "budget" is not an entirely satisfactory one for it may carry with it certain implications brought over from the governmental field. Governmental budgets from the point of sound principle should proceed from conservative estimates of revenues reasonably available and show activity and related expenditures planned accordingly, while commercial or business budgets should, to

serve their real purpose, be plans or programs prescribing an orderly development of the business or industry under consideration. Budgets approached from the viewpoint of governmental procedure, are always subject to the danger that the items of expenditures included therein be looked upon as appropriations definitely made for specific purposes and therefore to be spent, or again as bogeys which have been set up as standards of accomplishment. Any over-expenditure therefore brings risk of censure to those responsible. Of course, in any business enterprise, definite appropriations to be spent for certain particular activities have their proper place. So, too, do standards by which achievement may be measured, and these standards when set in advance furnish an incentive which may well result in increased individual effort and in a higher degree of team work. To use the commercial or business budget, however, solely for these purposes definitely defeats its end.

Why should a business enterprise budget or plan its course? The answer to this question is also a simple one. Planning is necessary because the modern economic system with its related social order is highly dynamic in character. What we usually call the economic machine is, in effect, a living organism. Conditions in the sphere of economic life are constantly in a state of flux. Change is ever in progress in markets, in sources of supply, in prices, in business organization, in methods of production and distribution, in habits of consumption—to name only a few of the elements of economic existence which every business man recognizes. And behind the outward and visible change in such elements as these, a process of modification is continually taking place in economic relationships, in ethical standards, in political beliefs, in social customs, morals, and ideals, and in all those fundamental and frequently intangible forces which wield an influence over the destinies of the human race and all of its institutions. Moreover, these changes do not occur in a steady uniform flow. On the contrary, they come

and go, they vary in intensity and in radius; they may be continuous, discontinuous, or periodic. In the case of any business institution, the objective of budgeting is to forecast these prospective changes, to appraise their probable importance, and to translate them into estimates, plans and policies relating to the future operations of the particular enterprise.

Budgeting programs should be made up in the light of the best available information at the time of preparation. They cannot, and should not, be regarded as strait-jackets within which the business is confined. Conditions change monthly, and even daily. Few indeed were the programs for last year, prepared let us say in the closing days of 1930, which did not require very substantial revisions during 1931. Clearly, in times like these planning or programming is more than ever needful but programs must be flexible and subject to continual readjustment. To be sure, the times are unusual, but in a sense all times are unusual. We never have lived and it is safe to say we never will live in a static world. How then can we plan or program most effectively? It seems to me that the answer is that it must be a continuous process, inseparable from the current operations of the business. The budget provides a means from time to time of taking stock, of bringing together anew the programs of the various departments of a business in order that they may be reviewed, revised if necessary, and coordinated so that the enterprise may be kept on an even keel and that expenses may be regulated in accordance with the probable overall results of operation. Approval of a budget or a program thus gives each of the various departments in the business assurance that its own particular program appears to be sound and may be undertaken. However, as time goes on, factors hitherto matters of estimate become matters of knowledge. Changes in the price levels of commodities, movements upward or downward in general business, the discovery that previous views of revenue or of the cost of certain activities no longer prevail—any of these factors may raise question

as to the desirability of modification of programs under which the company is currently proceeding. Summed up, continuous planning or programming subject to review as frequently as internal or external conditions warrant, appears to offer the best possible means of assuring that operations are kept well coordinated and that all departments are working harmoniously toward a common goal—this in brief is budgeting.

As to the form of budget or planning procedure best adapted to meet the idea of continuous programming, there are varying ideas. In the main there are two general types—"long term" and "short term" planning:

The line of demarcation between the two types may not be especially well defined; and of course the differentiation between them will tend to vary among different types of business enterprises. In general, "long term" planning may be described as comprising those processes of intelligent prevision which are necessary, first, for reaching sound conclusions in respect of such matters as the fundamental, rational status of an industry in economic society and the average level, or rate of growth, of business volume which is consistent with that status; and second, for the development of progressive business policies which are in tune with prospective economic and social trends. "Short term" planning, on the other hand, comprises those processes which are necessary for the determination and appraisal of the prospective changes in the economic and social order which are likely to be fleeting in character, and for the formulation of those temporary plans and practices best adapted to adjusting the particular business to these transitory conditions. Respecting "short term" planning, there has in recent years been a tendency on the part of some companies to provide that the budget be revised quarterly, each time an additional three-month period being added, thus furnishing a program which is continuously twelve months in advance. The Bell System telephone companies have adopted a somewhat different method which I shall later describe.

Whatever machinery is set up, however, it would seem that under no budget philosophy which is soundly conceived should programs be prepared, say, for a calendar year and then be forgotten, except for comparisons with actual results, until the time recurs for a new program to be outlined, for this practice of comparing actual results with prior estimates to measure accomplishment is of little value. The true measure of the degree of efficiency and economy with which work has been done can be obtained only through carefully devised unit cost methods. In other words, costs must be related to units of work actually performed rather than to the volume of work which it was expected would be done.

Let us assume, for example, that the budget is prepared for a twelve-month period, that the estimate is broken down on a monthly basis, and that comparisons are made each month between the budget figures and actual results. An overrun of an expense item for the early months of the period may be due to the fact that the program is proceeding more rapidly than was planned, in which event it may be expected that expenses for later months will show a corresponding falling off from the budget figures. On the other hand, such an overrun may occur when the program is proceeding as originally expected and may be due to the fact that the original estimates of cost were too low. Again, overall results may be running very close to those estimated although there has been a slippage in the program which has been offset by higher costs of the work done. Clearly, in the latter event the experience gained as to actual costs might warrant reconsideration of the program even though for the elapsed period overall results seems to be running very near those estimated. Budget comparisons with actual results are of little or no value until they have been analyzed in the light of the actual progress of work and such an analysis may be expected to be of aid only in determining whether or not the program continues to be a sound one. Budget comparisons to be of value must look toward the fu-

ture and their real worth lies in the light which they may throw on programs of work still ahead.

So much for the general philosophy underlying the use of the budget as an aid to the administration of any business enterprise. Let me now sketch briefly the methods and practices followed by Bell System telephone companies developed as the result of an experience of about twenty-five years in budget making. The Bell System comprises the American Telephone and Telegraph Company and twenty-four Associated Telephone Companies furnishing local and toll service within their own particular areas. The American Company is the parent organization, owning and operating the long distance telephone lines which connect the lines of the Associated Companies. It carries on research and development work for all of the System companies, not only along technical lines devoted to the advancement of the art of telephony but also in fields, such as accounting and statistical methods, operating methods, commercial methods, etc., where fundamental work, the results of which will be of value throughout the System, may more efficiently and economically be undertaken at a central point than at many places. A large staff organization, comprising over 7,000 persons, when the personnel in its laboratories is included, is maintained for this work and its services are at the disposal of the Associated Companies for advice and assistance on any problems which may arise. The American Company also does most of the financing necessary to provide for the growth of the System. The manufacturing of telephone apparatus is carried on for the System by the Western Electric Company which also acts as purchasing agent for the telephone companies.

The type of organization in each of the Associated Companies is functional, the work of the companies being handled by nine different departments. The traffic department, for example, has the responsibility for the handling of calls, the commercial department for business relations with users of the service, the plant department for the construction and mainte-

nance of the properties, the engineering department for the planning for plant extension and the determination of the type of plant to be built, and so on, each department being charged with its own particular function. Obviously, organizations of the type and size of the telephone companies can operate with a high degree of efficiency only if there is constant co-ordination of departmental efforts, not only in the current operations of the business but also in the preparation of plans for the future. Careful "long term" planning for the future with us has particular importance because we must continually be adding new plant. Most industries in times of depression can entirely suspend their growth; telephone companies cannot. Even in 1931, gross expenditures for construction and replacements aggregated nearly $400,000,000 while net additions to plant amounted to about $150,000,000. We sell service rather than goods, and with the extension of service there must be extension of plant facilities, even though other plant may not for the time being be fully used. Furthermore, it is of the highest importance that our new construction be planned wisely, not only to meet present needs but with a view to probable requirements for a considerable period in the future. For each important city there is accordingly maintained what is termed a fundamental "long term" plan, forecasting for some years ahead not only the probable growth in population and in requirements for telephone service but also in such matters as the probable geographical trend of business and residential sections. These plans, kept under frequent review, furnish the background for a long range program into which may be fitted the solution of such problems as the desirable location and size of central office buildings, the location of principal conduit and cable runs, etc. Similar fundamental plans are made regionally, outlining the probable future growth of toll traffic and developing a basis for handling the installation of cables, whether underground or aerial, in a manner which will be consistent with the long range view.

Thus there is back of our budget practice a great deal of systematic planning and fundamental research not translated at the moment into precise estimates of cost or even into definite work schedules but all contributing to give assurance that those projects under present consideration, when finally undertaken, will be so planned and engineered that they will form an orderly part of a comprehensive program looking some years into the future; a program designed to provide that there be no more facilities than are needed and no less than are required.

The "short term" budget or program, which in our business bears the name "provisional estimate," is prepared by each company annually in the late fall and covers the three following calendar years. It comprises estimates of the cost of plant to be added and that to be displaced in each year, of the number of telephones to be installed and those to be removed, of the revenues that will be obtained from the various types of service, and of expenses by main classification of accounts, arriving finally at an estimate of the net earnings and of the ratio of such earnings to the average plant in service. It also furnishes an estimate of cash requirements and resources for the year immediately following and estimates of the quantities of certain of the more important types of material and equipment which will be needed. The schedules of the various companies showing the amount of new money which will be required are consolidated to determine the total cash needs of the System, while those showing the quantities of material and equipment which will probably be needed furnish the information required for the determination of a manufacturing and purchasing program for the Western Electric Company.

So far as the first year of the provisional estimate is concerned, expenditures included therein are based on rather detailed estimates of the cost of carrying out specific programs, while for the last two years, except for large construction projects which must be scheduled well in advance, the figures are based to a considerable extent on projections of past experi-

ence modified by business judgment and by consideration of those factors which might cause appreciable changes in the general level of operation during the years in question. In some cases, companies may carry their estimates through for five years in advance. However, in the case of all estimates covering periods longer than those for which programs have been rather definitely worked out and scheduled, it is desirable to avoid attempting to obtain what engineers term "spurious accuracy." Since so many factors in the situation are subject to change as time advances, it is futile to seek refinement of detail. For most items, broad judgments as to trends and overall considerations will not only furnish adequate estimates as a basis for proceeding but will save expense and a great amount of unnecessary routine work.

In the preparation of estimates of the growth in number of telephones and of toll usage, together with revenues to be derived therefrom—factors which, of course, have a direct influence on work programs—it is necessary to formulate an opinion as to the probable trend of general business. The difficulty of forecasting movements of general business is, of course, particularly marked at times like the present when economic conditions in this country are complicated not only by its own economic problems but by the political problems of Europe and Asia. However, even under these conditions, we feel that such judgments should nevertheless be formulated in the light of the best information currently available rather than to rely upon a spirit of either blind optimism or hopeless pessimism. The statistical organization in each company therefore aims to keep in touch with current tendencies in general business within its own respective territory, while the statisticians of the American Company maintain contacts with many other lines of business and are continually studying conditions for the country as a whole. Indices which serve as measurements of current economic activity have been maintained for many years and are

under continual observation for the light which they may throw on the future. Certainly at the moment there is particular need for being on the alert to sense changes in general economic conditions, and the times emphasize the requirement that programs be kept flexible and subject to change as additional knowledge becomes available.

The adjustment of our budget program to changed conditions is met through periodic reviews of our programs at intervals during the year. The estimates for 1932 were prepared late in 1931 and were accompanied by an estimate of the various items by months for the first four months of 1932. As of May 1 the companies, with four months' experience behind them, will review and revise the figures both for the current year and for the year 1933. This review will be accompanied by another view by months for the next four-month period. The same process will be repeated as of September 1. In the preparation of these new views, revenue estimates are reconsidered, work programs are carefully reviewed, and the new view on receiving executive approval practically supplants the original estimate. Monthly comparisons of actual results with those estimated cover only the period since the latest review was compiled and are made from the viewpoint of throwing light on probable future performance.

In the preparation of reviews, the executives who have approved the original program will naturally seek explanation as to the causes for important changes therein. This gives them many items of useful information. Once the changes have been approved, however, the new view, as has been stated, supplants the earlier one. Thus we have what amounts to a continuing program, and our budget processes are tied into the day-to-day operation of the business. Programming is indispensable and should go on even without a budget. The budget, however, provides an effective means for bringing together all of the departmental programs that they may be co-ordinated

and adjusted in the light of revenue estimates and the probable overall results of operation. Briefly, the budget should be a tool of administration. It should provide a way in which programs may be controlled and not a mold into which a business is to be fitted. It should be a chart showing the course on which the business is proceeding, but also one which may be varied from as new knowledge becomes available.

I have referred to the present widespread interest in the subject of better industrial planning largely because of our experiences under present economic conditions. During the past fifty years this country has passed through one of the greatest industrial and scientific periods of all times. It was our expression of a desire for a better world, a higher standard of living. This epoch of our history drew to industrial and scientific pursuits some of the greatest minds of that period. Why? Because men love power and ability to achieve and will be drawn to the particular movement or activity which, for the time being, gives them the greatest opportunity to those ends. Scientific and industrial achievement in this period made possible the aeroplane, the automobile and tractor, the great steamships, the far reaching telephone and telegraph systems, the radio for communication and broadcast, the almost unlimited extension of the use of electricity for light, heat and power, the electric train, the largest of factories and industrial plants, and so on to mention only a few aspects of our material progress. In man's conquest of nature through science, he has revealed great secrets and with these he has organized the production and distribution of material necessities, comforts and luxuries of life into larger units. In this quest for improvement many things were rendered obsolete before we really had an opportunity to become acquainted with them.

In the United States alone during 1930 upwards of $200,000,000 was spent by research laboratories for industrial research of one type or another. Add to this sum the enor-

mous sums expended by laboratories for medical, social, governmental and other research to improve living conditions generally. Truly scientific research is one answer to our progress.

What does it mean for the future? Well, first, that we are not yet ready to fold up our tents and quit. It means great potential resources. It means far reaching changes in our social, economic and industrial life. It means that we can no longer isolate ourselves, that we cannot exist unaffected by what is happening in other lands. It means also that eventually there must come a common language for communication, a common currency as a medium of exchange, more uniform customs and standards of living, and through these and other changes will come better understanding, and differences and prejudices between nations should disappear and strife and warfare will be less possible. A new and finer world is in the making. Yet all of our progress has not been an unmixed blessing. There are definite evidences in our present economic situation that we have emphasized production and the tools of production and have overlooked some important aspects of the problems of distribution and consumption—decisive factors in our economic structure. Production without consumption may well prove a curse rather than a blessing. We have granaries filled with grain but not consuming power, we have the finest factories but at present no demand for their product. There is plenty of labor but no demand for its product, and with no demand for its product labor cannot buy. We have ahead the definite task of readjustment. Recognition must be given to the great increase that has taken place in recent years in the tempo of industrial and economic development, with changes compressed within a decade today that are as profound as those which were spread through a century or more before the alliance between science and business. This does not indicate that we should consciously attempt to retard the pace of progress, and have less new inventions and new technical processes,

but rather that we should adjust and keep adjusted our economic processes and economic behavior to our new plane of progress.

An important aspect of this problem is that of providing as far as possible continuous employment for the worker in industry. In times like these when millions are unemployed, private charity and action by local and state governments must be depended on to prevent suffering and to relieve distress. Such measures, however, are but palliatives. The only cure for idleness is productive employment, and it is only through providing work that we can insure the maintenance throughout our population of these qualities of responsibility and self-respect which are essential to the social well-being of the nation. There is much evidence that business leaders are recognizing more clearly than ever before their responsibilities in this direction, and are searching for plans which will provide for a greater degree of stabilization of employment. One constructive suggestion to this end may be helpful. Just as reserves are accumulated in prosperous years from which investors may benefit in years of adversity, so too we should come to provide reserves in prosperous years which may be drawn upon to provide work for or relief to employees during ebbs in the business tide.

What I have said is a constructive and not a destructive criticism of our industrial and economic order. Most of our present troubles are definitely the aftermath of the World War and will in due time pass by. Our troubles are, however, accentuated by the accelerated production ability of recent years as yet not fully co-ordinated with adequate processes of distribution and consumption, and also by some unwise use of our credit facilities. We have, however, already made progress in these matters when comparison is made with our not so distant past. In the depression of the early nineties and again in 1907 we had well advanced processes of production, and we also had

the same hectic conditions of unemployment, business and bank failures, and all the ills usually associated with such periods. The records and memories of those and earlier periods, however, do not reveal the same social and economic consciousness existing today, directed to keep the hardship and other ill effects of such periods at their minimum, nor the same universal interest in finding the cause of the trouble and the appropriate remedies therefor. Happily, too, we have today the means and the will to alleviate the adverse conditions confronting many of our people. As evidence, one need only to pick up a morning newspaper and there read of conferences of every description on the unemployment situation; conferences on correction and avoidance of business depressions; of efforts by community chests, welfare organizations and individuals to relieve suffering and distress; of bequests for hospitals; of cooperative efforts on the part of the employer and the employed to find a right solution of their differences; of efforts to eliminate waste and inefficiency; of efforts to improve our banking and credit processes; and of efforts to improve our taxation and governmental structure. When in history and in what country has such an effort based on voluntary and individual action been made?

The task of further adjusting and keeping adjusted our economic processes and our economic behavior to our new plane of progress is one in which we can all have a part, the engineer, the industrial leader, the scientist, the statesman, the banker, and not least of all the accountant with his understanding of business processes. It is a task which commands the finest type of mind, brains of the calibre which during the past fifty years led to our present productive ability. Industrial planning to be really effective must for the future consider these problems as fundamental and concern itself with a proper solution, if we are to continue as a great nation and a progressive people. The task comprises in part a proper viewpoint, more co-operation within industry, and greater industrial self-control, or self-gov-

ernment in business, rather than greater participation of government in business.

Is it too much to hope that with proper vision our budgeting or planning systems, designed to give proper recognition to these factors and then efficiently operated, will make not only increasingly valuable contributions to the financial success of business enterprises, but will also indirectly further the stability of our social and political institutions?

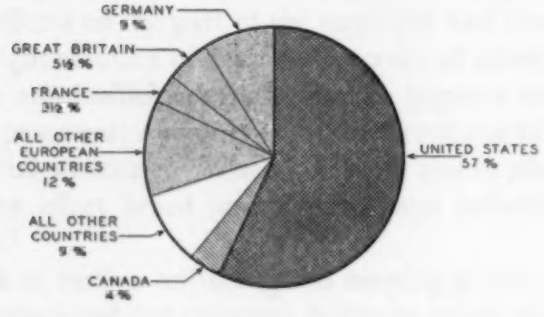
C. A. HEISS

World's Telephone Statistics

January 1, 1931

EACH year the Chief Statistician's Division of the American Telephone and Telegraph Company makes a comprehensive statistical survey of the number of telephones connected to the telephone systems of the world. With the gradual extension of international communication by radio-telephone, the data provided by this survey become increasingly interesting and significant. Every effort is made to secure accurate figures. Detailed questionnaires are sent to all the various tele-

DISTRIBUTION OF THE WORLD'S TELEPHONES
January 1, 1931

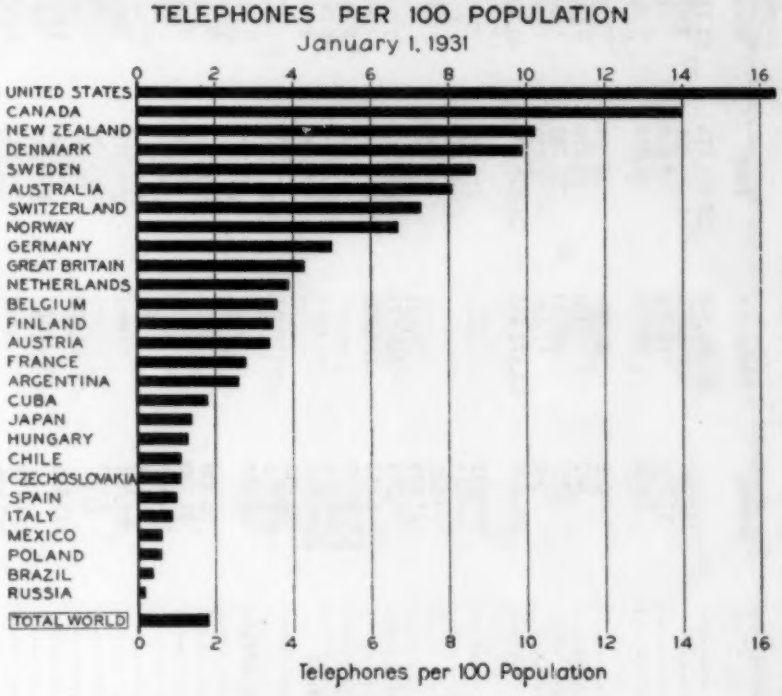


phone and telegraph administrations and systems throughout the world and, in the relatively few cases where authoritative data are lacking, careful estimates are made based on the records of previous years.

The survey for January 1, 1931 was recently completed. On that date there were 35,336,467 telephones in the world; of these, about 57 per cent, or 20,201,576 telephones, were in the United States. More than 99 per cent of these 20,201,576 telephones were either owned by, or connected to, the Bell System. Europe had 10,589,222 telephones, or about 30 per cent of the world's total; while the remaining 4,545,669 telephones

—13 per cent—were distributed among the countries of Asia, Africa, South America, Oceania and the parts of North America outside of the United States.

Despite the adverse economic conditions which generally prevailed throughout the world, there were 865,729 instruments added to the world's telephone systems during 1930. The increase in the United States was 133,553 telephones. Of the total telephones in the world, 10,860,000 instruments, or



about 31 per cent, were of the automatic or "dial" type. More than 50 per cent of these were in the United States.

As in other years, the results of the survey have been issued in the form of a printed bulletin from which the accompanying tables and charts have been taken.

Comparative Telephone Development of Countries

There were no significant changes during 1930 in the relative

TELEPHONE DEVELOPMENT OF THE WORLD, BY COUNTRIES

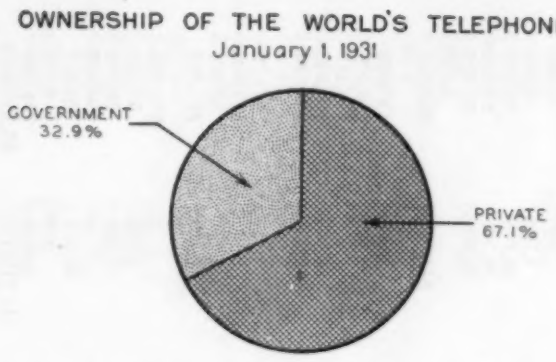
January 1, 1931

	Number of Telephones			Percent of Total World	Telephones per 100 Population	Increase in Number of Telephones During 1930
	Government Systems	Private Companies	Total			
NORTH AMERICA:						
United States	.....	20,201,576	20,201,576	57.17%	16.4	133,553
Canada	241,309	1,161,552	1,402,861	3.97%	14.0	2,875
Central America	11,893	13,376	25,269	.07%	0.4	638
Mexico	1,427	90,632	92,059	.26%	0.6	10,364
West Indies:						
Cuba	485	67,991	68,476	.20%	1.8	— 8,341
Porto Rico	602	11,776	12,378	.04%	0.8	118
Other W. I. Places*	8,222	13,531	21,753	.06%	0.3	1,198
Other No. Am. Places*	100	11,829	11,929	.03%	3.3	520
Total	264,038	21,572,263	21,836,301	61.80%	13.0	140,925
EUROPE:						
Austria	233,912	.....	233,912	.66%	3.4	11,676
Belgium	292,633	.....	292,633	.83%	3.6	32,960
Bulgaria*	19,000	.....	19,000	.05%	0.3	500
Czechoslovakia	147,028	17,451	164,479	.47%	1.1	6,772
Denmark (March 31, 1931)	13,593	340,722	354,315	1.00%	9.9	12,516
Finland	1,642	126,500	128,142	.36%	3.5	6,078
France	1,153,560	.....	1,153,560	3.26%	2.8	97,526
Germany	3,248,854	.....	3,248,854	9.19%	5.0	66,549
Great Britain and No. Ireland	1,996,897	.....	1,996,897	5.65%	4.3	110,171
Greece	12,800	.....	12,800	.04%	0.2	1,000*
Hungary	115,273	.....	115,273	.33%	1.3	13,960
Irish Free State (March 31, 1931)	30,601	.....	30,601	.09%	1.0	2,609
Italy (June 30, 1930)	.....	381,992	381,992	1.08%	0.9	48,935
Jugo-Slavia*	70,000	.....	70,000	.20%	0.5	3,000
Latvia (March 31, 1931)	51,530	.....	51,530	.15%	2.7	9,341
Netherlands	306,554	.....	306,554	.87%	3.9	22,121
Norway (June 30, 1930)	115,164	77,400*	192,564	.54%	6.7	4,326
Poland	108,683	90,696	199,379	.56%	0.6	13,277
Portugal	7,803	28,963	36,766	.10%	0.6	2,208
Roumania	.....	49,809	49,809	.14%	0.3	.....
Russia (October 1, 1930)¶	377,586	.....	377,586	1.07%	0.2	46,334
Spain	.....	222,382	222,382	.63%	1.0	37,840
Sweden	534,722	1,670	536,392	1.52%	8.7	27,331
Switzerland	297,930	.....	297,930	.84%	7.3	29,216
Other Places in Europe*	99,507	16,365	115,872	.33%	1.4	2,905
Total	9,235,272	1,353,950	10,589,222	29.96%	2.0	609,151

SOUTH AMERICA:						
Argentina*	.....	303,000	303,000	.86%	2.6	23,000
Bolivia	.....	2,333	2,333	.01%	0.1	— 174
Brazil*	674	162,000	162,674	.46%	0.4	3,000
Chile	.....	48,687	48,687	.13%	1.1	3,448
Colombia	2,500*	26,888	29,388	.08%	0.3	1,016
Ecuador	1,500	2,700	4,200	.01%	0.2	50
Paraguay	185	1,905	2,090	.01%	0.2	120
Peru	.....	13,745	13,745	.04%	0.2	446
Uruguay	.....	29,356	29,356	.08%	1.6	334
Venezuela	591	20,931	21,522	.06%	0.7	1,672
Other So. Am. Places*	2,830	.....	2,830	.01%	0.5	62
Total	8,280	611,545	619,825	1.75%	0.7	32,974
ASIA:						
British India*	22,000	35,000	57,000	.17%	0.02	100
China	84,000	69,000	153,000	.43%	0.03	— 3,000
Japan (March 31, 1931)	913,157	.....	913,157	2.58%	1.4	47,641
Other Places in Asia*	108,881	17,502	126,383	.36%	0.1	3,792
Total	1,128,038	121,502	1,249,540	3.54%	0.1	48,533
AFRICA:						
Egypt*	46,000	.....	46,000	.13%	0.2	1,000
Union of South Africa†	112,900	.....	112,900	.32%	1.4	3,963
Other Places in Africa*	86,871	1,320	88,191	.25%	0.1	5,854
Total	245,771	1,320	247,091	.70%	0.2	10,817
OCEANIA:						
Australia§	520,169	.....	520,169	1.47%	8.1	14,615
Dutch East Indies	49,447	4,598	54,045	.15%	0.1	951
Hawaii	.....	25,104	25,104	.07%	6.6	738
New Zealand†	164,739	.....	164,739	.47%	10.2	3,698
Philippine Islands	6,000*	20,017	26,017	.08%	0.2	3,113
Other Places in Oceania*	3,638	776	4,414	.01%	0.2	214
Total	743,993	50,495	794,488	2.25%	1.0	23,329
TOTAL WORLD	11,625,392	23,711,075	35,336,467‡	100.00%	1.8	865,729

* Partly estimated.
† March 31, 1931.
‡ Includes approximately 10,860,000 automatic or "Dial" telephones, of which more than 50% are in the United States.
§ June 30, 1930.
¶ U. S. S. R., including Siberia and Associated Republics.

standing of the principal countries in point of telephone development. The United States, with 16.4 telephones per 100 inhabitants, has the largest number of telephones in relation to population. Canada was the next best developed country, telephonically speaking, with 14.0 telephones per 100 population; then follow in order, New Zealand with 10.2, Denmark with 9.9, Sweden with 8.7 and Australia with 8.1 telephones per 100 population, respectively. The service in the United States is operated exclusively by private companies, and in Canada about 79 per cent of the telephones are privately owned



and operated. Germany, with more telephones than any other country except the United States, had only 5.0 telephones per 100 population or less than one-third the development provided by the telephone companies in the United States. Great Britain had a development of 4.3; this ratio is above that found in France, which had 2.8 telephones for each 100 inhabitants. Argentina continues to be the best developed country in South America, with 2.6 telephones per 100 population. Japan, the best developed country in Asia, had 1.4 telephones per 100 population, a ratio duplicated by the Union of South Africa, which is the leading country of Africa in point of telephone density. The relative telephone development of the principal countries of the world is shown on the chart on page 275.

TELEPHONE DEVELOPMENT OF LARGE AND SMALL COMMUNITIES

January 1, 1931

Country	Service Operated by (See Note)	Number of Telephones		Telephones per 100 Population	
		In Communities of 50,000 Population and Over	In Communities of less than 50,000 Population	In Communities of 50,000 Population and Over	In Communities of less than 50,000 Population
Australia (June 30, 1930)*	G.	295,165	225,004	9.0	7.1
Austria	G.	176,153	57,759	7.5	1.3
Belgium	G.	203,106	89,527	6.1	1.9
Canada	P. G.	730,000	672,861	23.7	9.7
Czechoslovakia	P. G.	65,543	98,936	4.1	0.8
Denmark	P. G.	158,910	192,400	17.5	7.2
Finland	P. G.	48,156	79,986	10.4	2.5
France	G.	676,125	477,435	7.5	1.5
Germany	G.	1,978,418	1,270,436	8.8	3.0
Great Britain and No. Ireland†	G.	1,432,700	588,900	5.7	2.8
Hungary	G.	85,675	29,598	4.9	0.4
Japan (March 31, 1931)	G.	548,762	364,395	3.5	0.7
Netherlands	G.	202,228	104,326	6.4	2.2
New Zealand (March 31, 1931)	G.	63,742	97,997	12.2	9.2
Norway (June 30, 1930)	P. G.	65,931	126,633	16.1	5.1
Poland	P. G.	111,500	87,879	2.9	0.3
Spain	P.	137,327	85,055	3.2	0.5
Sweden	G.	215,441	320,951	21.7	6.2
Switzerland	G.	130,809	167,121	15.5	5.2
Union of South Africa	G.	59,060	52,840	6.3	0.7
United States	P.	11,152,076	9,049,500	22.6	12.2

Note: P. indicates telephone service operated by private companies, G. by the Government, and P. G. by both private companies and the Government. See first table.

* Partly estimated.

† March 31, 1931.

Telephones in Large and Small Communities

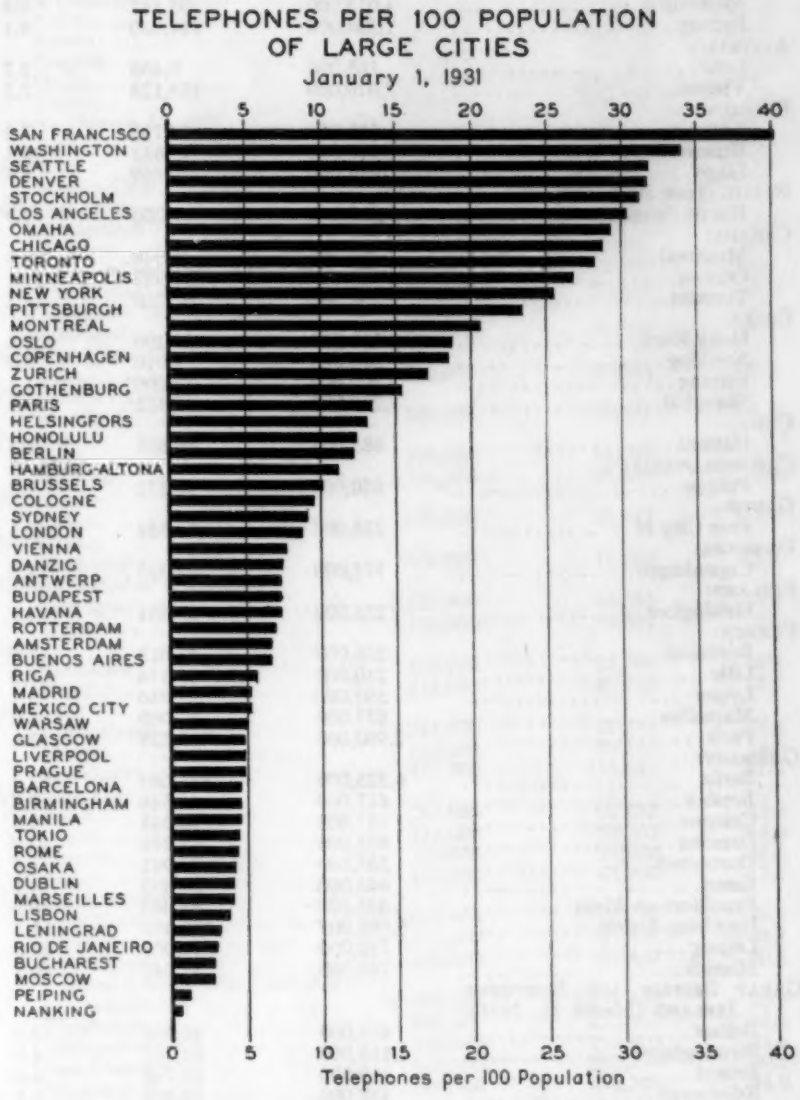
The table on "Telephone Development of Large and Small Communities," has a particular interest in that it indicates the extent to which telephone service is distributed between urban centers and the less populated areas. Examination of this table shows that in the case of the principal foreign countries, telephone facilities are restricted largely to the cities. Thus, in Germany there were only 3.0 telephones per 100 inhabitants in communities of less than 50,000 population, as against a development of 8.8 in communities of over 50,000 population. In Great Britain, we find a development in the less populated sections of 2.8, and in France a corresponding figure of 1.5. On the other hand, New Zealand, a small country with few large cities, reported a ratio of 9.2 telephones in communities of less than 50,000 population.

In the United States, however, the situation is radically different from European conditions. Our ratio of 12.2 telephones per 100 population in communities of less than 50,000 inhabitants reflects a high degree of development in the less densely populated sections—so high, in fact, that with the exception of Canada, no other country *as a whole* has a better telephone development than the smaller places in the United States.

Telephones in Large Cities

The relative telephone development of large cities throughout the world is shown on the accompanying chart. Of the twelve cities heading the list, ten are in the United States. San Francisco had the best development with 40.2 telephones per 100 population. Washington with 34.0, Seattle with 31.8, and Denver with 31.7 telephones per 100 population, respectively, are next in order. Then follows Stockholm with a development of 31.2 telephones per 100 population. The capital cities of France, Germany and Great Britain occupy relatively low positions on the chart. Thus Paris is eighteenth, Berlin twenty-first, and London twenty-sixth, with developments of

13.4, 12.2 and 8.7 telephones per 100 population, respectively. The accompanying table, "Telephone Development of Large



Cities," indicates even more strikingly the relative superiority of the American cities as regards telephone service. The aver-

TELEPHONE DEVELOPMENT OF LARGE CITIES
January 1, 1931

Country and City (or Exchange Area)	Estimated Population (City or Exchange Area)	Number of Telephones	Telephones per 100 Population
ARGENTINA:			
Buenos Aires	2,486,000	163,057	6.6
AUSTRALIA:			
Adelaide	324,000	30,422	9.4
Brisbane	313,000	24,868	7.9
Melbourne	1,015,000	95,117	9.4
Sydney	1,254,000	114,630	9.1
AUSTRIA:			
Graz	165,000	9,469	5.7
Vienna	2,020,000	155,128	7.7
BELGIUM:			
Antwerp	519,000	37,795	7.3
Brussels	948,000	95,632	10.1
Liege	424,000	20,669	4.9
BRAZIL (June 30, 1931):			
Rio de Janeiro	1,600,000	47,000	2.9
CANADA:			
Montreal	950,000	195,976	20.6
Ottawa	184,300	38,883	21.1
Toronto	735,500	207,218	28.2
CHINA:			
Hong Kong	500,000	12,100	2.4
Nanking	570,000	2,910	0.5
Peiping	1,200,000	13,000*	1.1
Shanghai	1,200,000	35,432	3.0
CUBA:			
Havana	685,000	49,801	7.3
CZECHOSLOVAKIA:			
Prague	850,000	40,571	4.8
DANZIG:			
Free City of	235,000	17,534	7.5
DENMARK:			
Copenhagen	771,000	142,323	18.5
FINLAND:			
Helsingfors	255,000	33,384	13.1
FRANCE:			
Bordeaux	266,000	21,013	7.9
Lille	210,000	15,116	7.2
Lyons	592,000	29,946	5.1
Marseilles	677,000	27,080	4.0
Paris	2,980,000	400,528	13.4
GERMANY:			
Berlin	4,325,000	525,689	12.2
Breslau	617,000	44,546	7.2
Cologne	737,000	70,045	9.5
Dresden	633,000	63,278	10.0
Dortmund	535,000	23,941	4.5
Essen	648,000	30,495	4.7
Frankfort-on-Main	625,000	68,405	10.9
Hamburg-Altona	1,605,000	179,435	11.2
Leipzig	710,000	71,003	10.0
Munich	740,000	77,642	10.5
GREAT BRITAIN AND NORTHERN IRELAND (March 31, 1931):			
Belfast	415,000	16,060	3.9
Birmingham	1,168,000	52,502	4.5
Bristol	410,000	18,740	4.6
Edinburgh	439,000	28,468	6.5
Glasgow	1,176,000	56,100	4.8
Leeds	506,000	21,751	4.3
Liverpool	1,178,000	56,185	4.8
London	8,210,000	712,493	8.7
Manchester	1,091,000	61,152	5.6
Newcastle	468,000	18,418	3.9
Sheffield	512,000	18,708	3.7
HAWAII:			
Honolulu	139,000	17,273	12.4
HUNGARY:			
Budapest	1,005,000	73,768	7.3
Szeged	135,000	2,452	1.8

TELEPHONE DEVELOPMENT OF LARGE CITIES (Concluded)

January 1, 1931

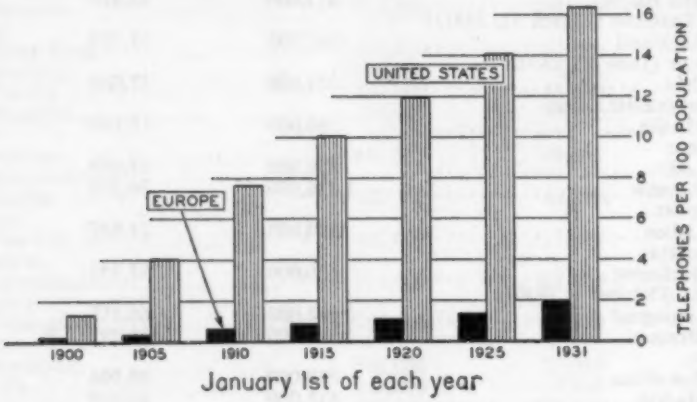
Country and City (or Exchange Area)	Estimated Population (City or Exchange Area)	Number of Telephones	Telephones per 100 Population
IRISH FREE STATE (March 31, 1931):			
Dublin	412,000	16,338	4.0
ITALY:			
Genoa (January 1, 1930)	628,000	22,516	3.6
Milan	928,000	68,253	7.4
Rome (January 1, 1930)	950,000	40,393	4.3
JAPAN (March 31, 1931):			
Kobe	788,000	29,562	3.8
Kyoto	815,000	34,196	4.2
Nagoya	907,000	28,748	3.2
Osaka	2,454,000	101,478	4.1
Tokio	3,410,000	151,000	4.4
LATVIA (March 31, 1931):			
Riga	385,000	21,677	5.6
MEXICO:			
Mexico City	955,000	49,334	5.2
NETHERLANDS:			
Amsterdam	752,000	49,670	6.6
Haarlem	148,000	10,051	6.8
Rotterdam	598,000	41,510	6.9
The Hague	472,000	43,476	9.2
NEW ZEALAND (March 31, 1931):			
Auckland	207,000	21,759	10.5
NORWAY (June 30, 1930):			
Oslo	252,000	47,064	18.7
PHILIPPINE ISLANDS:			
Manila	380,000	17,199	4.5
POLAND:			
Lodz	836,000	13,699	1.6
Warsaw	1,116,000	56,332	5.0
PORTUGAL:			
Lisbon	590,000	21,837	3.7
ROUMANIA:			
Bucharest	630,000	17,103	2.7
RUSSIA (October 1, 1930):			
Leningrad	2,228,000	68,255	3.1
Moscow	2,780,000	74,391	2.7
SPAIN:			
Barcelona	850,000	38,104	4.5
Madrid	815,000	42,218	5.2
SWEDEN:			
Gothenburg	244,000	37,588	15.4
Malmö	128,000	18,735	14.6
Stockholm	428,000	133,441	31.2
SWITZERLAND:			
Basel	147,000	22,885	15.6
Berne	112,000	18,562	16.6
Geneva	143,000	21,956	15.4
Zurich	250,000	42,750	17.1
UNITED STATES:†			
New York	7,014,900	1,786,270	25.5
Chicago	3,424,000	981,325	28.7
Los Angeles	1,320,000	401,887	30.4
Total 8 cities over 1,000,000 population	19,602,800	4,875,830	24.9
Pittsburgh	987,300	231,435	23.4
Milwaukee	725,100	158,003	21.8
San Francisco	653,300	262,470	40.2
Washington	508,500	172,998	34.0
Total 10 cities with 500,000 to 1,000,000 population	6,927,700	1,605,282	23.2
Minneapolis	497,600	133,477	26.8
Seattle	403,900	128,447	31.8
Denver	290,100	91,965	31.7
Omaha	228,800	67,102	29.3
Total 34 cities with 200,000 to 500,000 population	10,228,400	2,204,289	21.6
Total 52 cities with more than 200,000 population	36,758,900	8,685,401	23.6

* Partly estimated.

† There are shown, for purposes of comparison with cities in other countries, the total development of all cities in the United States in certain population groups and the development of certain representative cities within each of such groups.

age development of all cities (fifty-two) in this country with more than 200,000 population was 23.6, a figure which exceeds that for any single large foreign city except Stockholm and Toronto. Chicago, with its 981,325 telephones, had a development of 28.7, while the corresponding figure for New York, with 1,786,270 telephones, was 25.5. Yet Chicago had less than 5 per cent, and New York less than 9 per cent, of the total number of telephone instruments in the United States. Lon-

TELEPHONE DEVELOPMENT
IN THE UNITED STATES AND EUROPE



don, on the other hand, had 712,493 telephones, or about 36 per cent of all the instruments in Great Britain; Paris, with 400,528 telephones, had 35 per cent of all the instruments in France. More than one fourth of all the telephones in Germany were located in the cities of Berlin, Hamburg-Altona, Leipzig and Munich. These figures, in other words, bring out still more emphatically the fact that in foreign countries telephone facilities are largely concentrated in the urban areas, despite the cognate fact that even these cities are less generously provided with telephone service than are American cities.

Notes on Recent Occurrences

BELL SYSTEM PUBLICITY CONFERENCES

ON March 15 and 16 the Publicity Managers of the Eastern Group of Associated Companies of the Bell System met in New York for a conference on matters pertaining to advertising and public relations, and on March 22 and 23 a similar meeting was held in Chicago attended by representatives of the Western Companies. The two conferences were conducted by Arthur W. Page, Vice President of the American Telephone and Telegraph Company.

LONG DISTANCE HEADQUARTERS MOVED

THE general and division offices of the Long Lines Department of the American Telephone and Telegraph Company have been moved from scattered offices to the Department's newly finished headquarters in the Long Distance Building at 32 Sixth Avenue, New York, which now houses about 5,500 people.

Thirty-two Sixth Avenue, known as 24 Walker Street before it was remodelled and doubled in size, is the largest long distance center in the world. It is the crossroads of all main trunk routes of the Bell System in the Northeast. It has direct telephone circuits to many important cities in the United States, Canada and Cuba, and to the switching points for Mexico. All calls from North America for Europe, South America, the Far East and ships at sea, are handled in this building.

In addition to all the telephone lines passing through it, the Long Distance Building is the principal nerve center for the great radio chains. Here is located the control room for the nation-wide hook-ups furnished to the broadcasting companies.

The building also houses the Bell System's largest teletypewriter exchange. All private wires furnished by the Bell System from New York to distant cities, whether by telephone, teletypewriter or telegraph, are brought through the building.

The construction activities just completed involved the erection of two new buildings, merging with the original building. The project involved changing the old twenty-four story building to a twenty-eight story building covering the entire block between Sixth Avenue and Church Street and between Walker and Lispenard Streets, or nearly twice the ground occupied by the old building. The new building rests on islands consisting of reinforced concrete mats.

It was necessary to relocate some 200 telephone cables in a new cable vault and to move cables here and there throughout the building. On account of the necessity for maintaining uninterrupted service, these alterations produced complicated and difficult problems.

One feature of the new structure makes it unique. This is a truss 90 feet long and weighing 52 tons, suspended 450 feet above the street level. This truss, together with a cantilever arrangement, supports four floors above the old building. The arrangement was necessary because the foundation and framework of the old building were not designed to support the extra weight which these four floors would impose.

In addition to the numerous switchboards, test boards and other equipment connected with telephone and telegraph operations, the new structure contains an assembly room seating 500, three cafeterias, complete medical department and rest and recreation facilities. Another feature is a dormitory for the use of operators coming off duty at late hours.

The original structure was erected in 1912. Seven floors were added in 1917, which provided space for local exchange equipment as well as toll. Today long distance facilities occupy the equivalent of nearly thirty floors of the old building.

The Long Distance Building in its new form was designed by Voorhees, Gmelin and Walker. Marc Eidlitz and Son, Inc., were the contractors.

JOINT N. E. L. A.—BELL SYSTEM SUBCOMMITTEES MEET

THE semi-annual meeting of Division One of the Joint Subcommittee on Development and Research of the National Electric Light Association and the Bell System was held at 195 Broadway, New York, on May 18, 1932. R. G. McCurdy, Bell System chairman of the division, presided. Other officers of the division included W. F. Davidson and H. E. Kent, division chairman and secretary, respectively, for the N. E. L. A., and R. A. Shetzline and P. W. Blye, division vice chairman and secretary, respectively, for the Bell System.

Division One is charged with the joint development work having to do with noise frequency co-ordination, and the discussion at this meeting was confined to this subject. Progress reports were presented by the five Project Committees of the division on the work of the past six months on the study of noise induction in toll and local lines, on the evaluation of noise, on the wave shape of power systems, and on the use of selective devices in noise-frequency problems.

The semi-annual meeting of Division Two of the Joint Subcommittee on Development and Research, on Low Frequency and Structural Co-ordination, was held at N. E. L. A. headquarters on May 19. The meeting was presided over by the joint chairman, A. E. Silver representing the N. E. L. A. and H. S. Warren representing the Bell System. Drafts of the progress reports of the ten project committees were presented for technical discussion. As a result of this discussion, the progress reports will be revised and presented to the Joint Subcommittee at their next meeting.

ACADEMIC HONORS FOR BELL SYSTEM MEN

F. B. JEWETT, Vice-President of the American Telephone and Telegraph Company and Vice-President of Bell Telephone Laboratories, Inc., has received the honorary degree of Doctor of Laws from Miami University, Oxford, Ohio.

Sergius P. Grace, Assistant Vice-President of Bell Telephone Laboratories, Inc., and well-known for his popular lectures on the science of communication, has received the honorary degree of Doctor of Laws from Notre Dame University, and the honorary degree of Doctor of Engineering from the University of Michigan.

Gustaf W. Elmen, inventor of the magnetic alloys permalloy and perminvar, and in charge of the Bell Telephone Laboratories' research in magnetic materials, has received the honorary degree of Doctor of Engineering from his alma mater, the University of Nebraska.

OVERSEAS TELEPHONE SERVICE TO SOUTH AFRICA

REGULAR radio-telephone service between North American telephones and South Africa began on June 1. Conversations are handled through the transatlantic radio telephone stations of the American Telephone and Telegraph Company, working with the British Post Office stations in England, where the calls are switched to the London-Cape Town radio circuit. The total length of the circuit from New York to Cape Town is about 9,500 miles.

The radio stations in Africa are owned by the Overseas Communication Company of South Africa. The transmitter is at Klipheuval, the receiver at Milnerton, both about forty miles from Cape Town. Territory reached by the service includes, besides Cape Town, the towns of DeAar, Port Elizabeth and other nearby points. All Bell System telephones in the United States are within the scope of the service, together with Bell-connecting telephones in Canada, Cuba and Mexico.

At the beginning the daily service period is from 3:30 a.m. to 8:30 a.m., New York daylight saving time, corresponding to 9:30 a.m. to 2:30 p.m. in Cape Town. Later it is hoped to extend these hours. A three-minute conversation between New York and Cape Town costs $45, with $15 for each minute of overtime.

The opening of this service marked the first major extension of commercial telephone service to Africa from the United States. Both links in the connection are radio circuits. Previously a single African city, Ceuta in Spanish Morocco, could be connected with North America over cables spanning the Straits of Gibraltar and land wire links to the radio terminals in Great Britain.

SHIP–TO–SHORE TELEPHONE EXTENDED TO SIX GERMAN SHIPS

ON JUNE 7, commercial ship-to-shore telephone service was extended to the S. S. *Bremen* from the radio stations of the American Telephone and Telegraph Company, located at Forked River, N. J., and Ocean Gate, N. J. The *Bremen* was the second German liner to be included in the service, as the S. S. *Deutschland* was added to the vessels so equipped on her voyage from New York early in May. Service to the *Europa, Albert Ballin, Hamburg,* and *New York* was subsequently placed in operation. Apparatus on these liners is owned and operated by D. E. B. I. G., the German radio operating company.

As in the case of the other transatlantic liners having ship-to-shore connections with North America, these ships while at sea will be able to reach all Bell System telephones in the United States, as well as those connecting with the System in Canada, Mexico, and Cuba. The same schedule of charges will prevail, namely, $9 for a three-minute call to New York and vicinity while within 500 miles of that port, and $18

when connections are established when the vessel is further out at sea.

MR. CHARLESWORTH ELECTED PRESIDENT OF A. I. E. E.

HARRY PRESCOTT CHARLESWORTH, Vice-President of Bell Telephone Laboratories, Inc., has been elected President of the American Institute of Electrical Engineers. Announcement of the election was made on June 20 at the annual convention of the Institute in Cleveland.